AS-7417

INSTRUCTION MANUAL

FOR

TYPE AH-5403 RADIO TELEPHONE TESTER

ANDO ELECTRIC CO., LTD.

AS-7417

INSTRUCTION MANUAL

FOR

TYPE AH-5403 RADIO TELEPHONE TESTER

Contents

SECTION 1
GENERAL INFORMATION

1.1 Introduction

This manual provides instructions for the operation of the TYPE AH-5403 RADIO TELEPHONE TESTER.

1.2 General

This apparatus is a multi-function test equipment developed for use in the maintenance and servicing of all FM mobile transceivers such as simplified service transceivers, general service transceivers, etc. in the 25 to 520 MHz band.

There will be no equipment which requires a greater variety of measuring instruments from low to high frequencies in its adjustment or inspection than the transceiver. For example, a man may almost be buried among measuring instruments from the circuit tester to the spectrum analyzer while the transceiver is in the palm of his hand. Operating procedures involved are complicated such that connections must be changed for each measurement item, and adjustment or measurement is time consuming. All these difficulties can be overcome by this multi-function measuring equipment which has the following features.

1.3 Features

(1) Only selection of the measurement item is sufficient. It is not necessary that connections should be changed for each measurement item.

(2) All essential functions for measurement or checking of the characteristics of FM mobile transceivers are collected in this apparatus in the form convenient for carrying about or movement.

(3) In spite of multi-function, this apparatus is easy to operate and makes possible highly accurate measurement.

(4) Even if the transceiver is brought erroneously into the transmitting condition while the RF signal generator is in operation, the input/output circuit is protected, the output attenuator

being not burned out, and there being no need of replacement of RF fuse, etc.

(5) The RF signal generator and the AF oscillator of the synthesizer system have as high accuracies as $\pm 0.1 \times 10^{-6}$.

(6) The FM linear detector has a deviation scale of 1 kHz full scale which enables accurate measurement of deviations of tone signals, as well.

(7) The RF power meter has a linear scale of Watt which enables accurate measurement of low powers, as well.

(8) A frequency counter is contained, and a frequency multiplier enabling accurate measurement of low frequencies (10 to 260 Hz) in a short time if provided.

1.4 Functions

This apparatus has the following functions.

(1) RF signal generator

Of the synthesizer system in 100 Hz steps. FM modulation can be applied. Simultaneous modulation (system modulation) by a modulation signal (1 kHz internal modulation or 50 to 2999 Hz AF test signal) and a CCTS tone signal can be applied.

(2) Frequency counter

Frequency counter for 7-digit measurement of 10 Hz to 520 MHz.

A frequency multiplier (X 1000) is contained to enable accurate measurement of 10 to 260 Hz signal within 0.1 second.

(3) RF power meter

Large power measurement can be made. (25W: continuous, 30W: 1 minute on and 5 minutes off). This meter having a linear scale of Watt is also suitable for low power (100 mW) measurement, as well.

(4) FM linear detector

This detector having a deviation range of 1 kHz full scale enables accurate measurement of deviations of CTCSS tone signals. The demodulation band is from 400 Hz to 3 kHz or from 30 Hz to 3 kHz as switched.

(5) 1 kHz oscillator

This oscillator provides 1 kHz test tones used as the modulation signal for the transmitter and receiver.

(6) AF level meter-distortion factor meter

Level meter of 30 Hz to 10 kHz capable of distortion factor measurement at 1 kHz. Measurement of the 20 dB NQS or measurement of SINAD can also be made easily.

(7) AF oscillator

Of the synthesizer system to provide tone signals of 50 to 299.9 Hz in 0.1 Hz steps and AF test signals of 50 to 2999 Hz in 1 Hs steps.

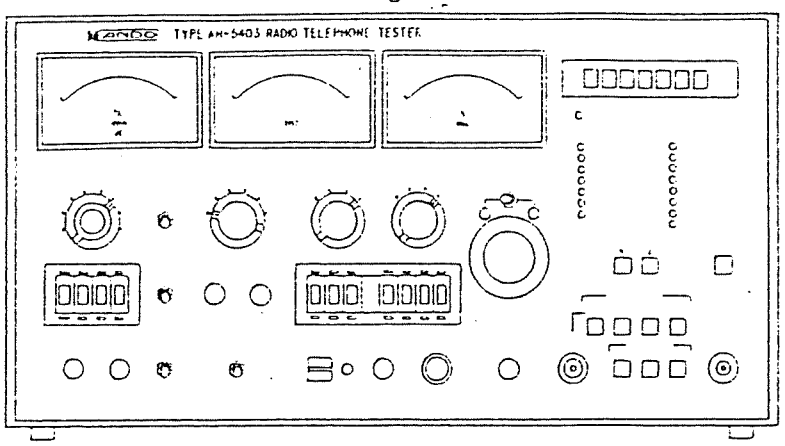
(8) Monitor output

Waveforms of demodulation signals, distortion components in the distortion factor measurement, noise components in the S/N measurement, etc. can be observed on an oscilloscope. An output terminal for loudspeaker is also provided at the rear for voice signal monitoring.

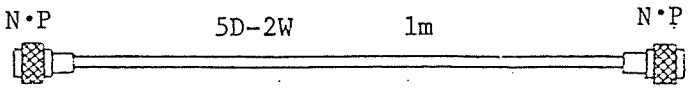
1.5 Composition

The standard composition of this apparatus is shown Fig. 1-1.

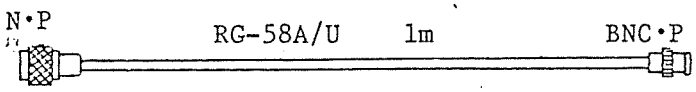
Fig. 1-1



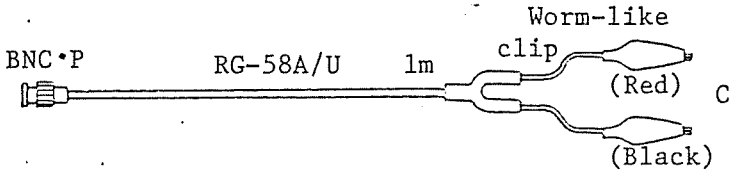
Type AH-5403 radio telephone tester proper × 1



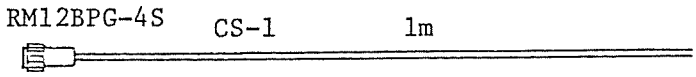
50Ω coaxial cable × 1



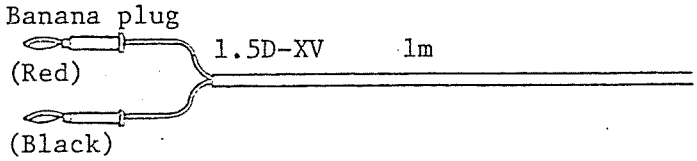
50Ω coaxial cable × 1



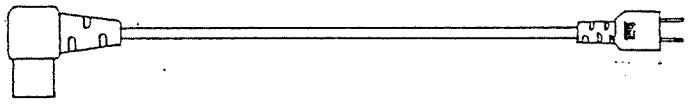
Coaxial cable × 1



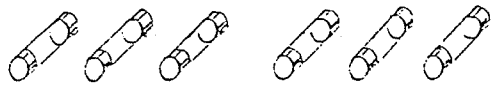
Microphone cord × 1



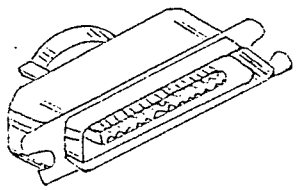
AF cord × 1



Power cord × 1

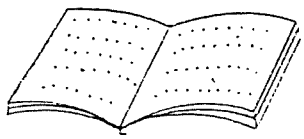


Fuse 1.25A × 3
0.5A × 3
(Normal use and spare)



57-30500

Connector for remote control × 1



Instruction manual 1 copy

1.6 Specifications

The specifications and general performance characteristics of this apparatus are shown in Table 1-1.

Table 1-1 Specifications

Name	Performance
(1) Overall performance	
RF input/output impedance	50Ω unbalanced, VSWR less than 1.1
Frequency range	25 to 520 MHz, synthesizer system, in 100 Hz steps (with use of digital switch)
Reference frequency accuracy	$\pm 0.1 \times 10^{-6}$
(2) RF signal generator	
Output level	- 10 to + 80 dBμ (0 dBμ = 1 μV open voltage) in 10 dB steps and from + 1 to - 10 dB continuously variable
Output level accuracy	± 2 dB (output level 0 dBμ)
Spurious	Harmonics - 30 dB or lower Non-harmonics - 40 dB or lower (within the specified frequency range)
FM modulation	0 to ± 1/± 5/± 10, ± 20 kHz/full scale
Deviation meter indication accuracy	± 10% of full scale
Internal modulation frequency	1 kHz and 50 to 2999 Hz (System modulation can be applied.)
External modulation frequency	50 Hs to 3 kHz
External modulation input level	1 Vrms or less (± 20 kHz deviation)
Modulation distoriton factor	Less than 1% (± 3.5 kHz deviation, demodulation band 400 Hz to 3 kHz)

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Name	Performance
Signal to noise ratio	More than 42 dB (± 3.5 kHz deviation, demodulation band 400 Hz to 3 kHz)
(3) RF power meter	
Maximum measurable power	25W (continuous) 30W (1 minute on and 5 minutes off)
Minimum measurable power	100 mW
Scale	0 to 1.5/7.5/15/30W/full scale Linear scale of Watt
Scale accuracy	± 10% of full scale
(4) FM linear detector	
Deviation range	0 to ± 1/± 5/± 10, ± 20 kHz/full scale The range of ± 1 kHz/full scale is used for tone signal deviation measurement. The demodulation band is from 30 Hz to 500 Hz.
Deviation meter indication accuracy	± 10% of full scale
Deviation meter indication system	Peak detection (p-p/2)
Demodulation frequency range	30 Hz to 3 kHz and 400 Hz to 3 kHz
Distortion factor	Less than 1% (± 3.5 kHz deviation, demodulation band 400 Hz to 3 kHz)
Signal to noise ratio	More than 42 dB (± 3.5 kHz deviation, demodulation band 400 Hz to 3 kHz)
(5) Frequency counter	
Frequency range	10 Hz to 520 MHz
Frequency accuracy	$\pm(0.1 \times 10^{-6} + 1$ count)
Input impedance	1 MΩ unbalanced, 10 Hz to 50 MHz range 50Ω unbalanced, 50 to 520 MHz range

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Name	Performance
Input sensitivity	20 mVrms
(6) AF signal output (signal source microphone)	
Frequency	1 kHz, 50 to 2999 Hz and external signal
Output impedance	Suitable for 600Ω load, unbalanced. Usable with 40Ω load.
Output level	Within - 5 ± 1 dBm to - 50 dBm or lower (600Ω resistance load)
Distortion factor	Less than 0.3% (1 kHz and external signal)
(7) AF level meter-distortion factor meter	
(AF level meter)	
Level measuring frequency range	30 Hz to 10 kHz
Input impedance	600Ω and 100 kΩ
Measuring range and scale	+ 20 to - 50 dBm (600Ω)/full scale, 8 ranges
Scale accuracy	± 1 dB
(Distortion factor meter)	
Distoration factor measuring frquency	1 kHz ± 10 Hz
Fundamental rejection ratio	More than 50 dB
Measuring range and scale	0 to - 40 dB/full scale 100 to 1%/full scale } 5 ranges (For 0 dBm or higher input level, + 10, + 20 dB attenuator is available.)
Scale accuracy	± 10% of full scale
(8) AF oscillator	
Frequency range	50 to 2999 Hz in 1 Hz steps

Name	Performance
Output impedance	Sutitable for 600Ω load, unbalanced.
Output level	Within 5 ± 1 dBm to - 30 dBm or lower (600Ω resistance load)
Distortion factor	Less than 1%
(9) Monitor output	
Output level	About 0.8 Vrms at meter full scale of AF level meter (10 kΩ resistance load)
Audio monitor	Terminal for external loudspeaker is provided.
(10) Others	
Operating temperature range	+ 5° to + 35°C
Operating temperature range	0° to + 40°C
Stonage temperature range	- 20° to + 60°C
Power requirements	AC 90 to 132V/198 to 264V, 48 to 63 Hz, approx. 80 VA
Dimensions	Approx. 222(H) x 425(W) x 350(D) mm Approx. 222(H) x 425(W) x 390(D) mm (including the cover)
Weight	Approx. 20 kg

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SECTION 2
PREPARATION FOR OPERATION

2.1 Introduction

This section describes unpacking and acceptance inspection, and repacking.

2.2 Unpacking and Acceptance Inspection

This apparatus is subjected, before shipment from the factory, to mechanically and electrically adequate inspection to guarantee its normal operation. Upon receipt of the apparatus, promptly unpack and check for damage in transportation.

When unpacking, it is recommended to take care to damage wooden boxes, cushioning materials, internal packaging corrugated cardboard boxes, etc. as little as possible, except packing expandables such as steel bands and wrapping papers, and keep them in custody so that they may be reused for reshipment.

2.3 Mechanical Check

Check the appearance, switch operation and knobs of this apparatus for damage or other abnormal symptoms which may have been caused in transportation. Moreover, check the accessories and spare parts for their kinds and quantities against the packing list.

2.4 Performance Check

If no abnormal symptom is found in the mechanical check, then check the performance by performance test.

2.5 If any Damage of Abnormal Symptom is Found

If any damage or abnormal symptom against the specifications is found in this apparatus in the acceptance inspection, then immediately report the details to the nearest representative (or factory).

2.6 Repacking

When repacking for reshipment, use the packing materials which have been kept in custody from the acceptance inspection. If these materials are damaged or missing and can not be used, repack this apparatus in the following manner.

(1) Wrap this apparatus in a strong paper like tarpaulin paper or a vinyl sheet. Protruding portions should be covered with cushions beforehand, to prevent damage.

(2) Place the package prepared as descrived in (1) above in a wooden box or corrugated cardboard box which has a margin of about 10 cm on all sides with respect to the size of this apparatus.

(3) Fill all spaces around the package in the wooden box sufficiently with polyurethane foam or any other cushioning material. If the cushioning material is not sufficient, the apparatus may be damaged due to vibration in transportation.

(4) Place the cover on the wooden box, and then, seal with steel bands. In the case of the corrugated cardboard box, use an adhesive tape or the like to firmly seal after closing the cover.

(5) At some visible location on the container, clearly mark the contents and address of the shipment in a permanent way.

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SECTION 3

OPERATING INSTRUCTIONS

3.1 Introduction

This section describes explanations of the operating controls of this apparatus and their operating procedures.

3.2 Nomenclature of Operating Controls

The location, name and functional explanation of the operating controls of this apparatus are shown in Fig.3-1 (front panel) and Fig.3-2 (rear panel). By reference to these figures, reads the explanations of the operating controls given in Table 3-1 (front panel) and Table 3-2 (rear panel).

Table 3-1 Explanation of operating controls (front panel)

No.	Name	Functional explanation
①	[LINE] [OFF] [ON] (power switch)	Push-button switch to turn on power supply at [ON] of depressed condition. When this button is redepressed, it springs out to the condition of [OFF] to turn off power supply.
②	[RF INPUT/OUTPUT 50Ω MAX. 25W] (RF input/output connector)	Connector to be connected to the antenna connector of the transceiver. A power of continuous 25W or maximum 30W (1 minute on and 5 minutes off) can be input. Large powers applied erroneously to this apparatus during operation as the RF signal generator or FM linear detector will not damage it.
③	[▼] [▲] (Measuryement item selector switch)	When [▼] is depressed, the measurement item is shifted downward, and when [▲] is depressed, it is shifted upward. One time of depression causes shifting by one item. Continued depression for 1 or 2 seconds causes automatic shifting

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No.	Name	Functional explanation
		until the button is released at the desired measurement item. The selected measurement item is indicated by the lighting of the measurement item lamp of ④. At the same time, internal connections are changed to complete the set-up for measurement.
④	Measurement item lamp	To indicate the measurement item set by means of the measurement item selector switch of ③. The measurement item of [TRANSMITTER TEST] is indicated in red, and the measurement item of [RECEIVER TEST] is indicated in green.
		[TRANSMITTER TEST] shown measurement items for transmitter test of the transceiver. There are the following items. [OUTPUT (REAR)] A 40 dB attenuated (1/10000) output of the transmitter power of the transceiver is available at [RF OUTPUT] of the rear panel. Used for spectrum observation, etc. of the transceiver. [RF FREQUENCY (ΔF)] Used for measurement of any deviation of the transmit frequency of the transceiver from the reference frequency (frequency set by means of ⑪ of this apparatus). [AUDIO SENSITIVITY] Used for measurement or adjustment of the FM modulation sensitivity of the transceiver.

No.	Name	Function explanation
		[AF LEVEL SET] Used for 100% setting of the AF level meter in the measurement of the FM modulation rate of the transceiver or the distortion factor or S/N measurement. [DISTORTION] Used for measurement of the distortion factor. The fundamental frequency of 1 kHz is eliminated and the distortion factor is indicated on the level meter. [S/N] Used for measurement of the S/N ratio of the transceiver with the modulation signal automatically shut off. [TX MOD FREQUENCY] Used for measurement of the modulation signal frequency or tone signal frequency.
		[RECEIVER TEST] shows measurement items for the receiver test of the transceiver. There are the following items. [AF INPUT LEVEL] Used for measurement or adjustment of the audio frequency output level of the receiver. [AF LEVEL SET] Used for 100% setting of the AF level meter in the distortion factor or S/N measurement of the receiver. [DISTORTION] Used for measurement of the distortion factor. The fundamental frequency of 1 kHz is automatically eliminated. [S/N] Used for measurement of the S/N ratio

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No.	Name	Functional explanation
		of the receiver with the modulation signal automatically shut off. [20 dB NQS] [N SET] [MEASURE] Used for measurement of the 20 dB NQS (20 dB noise quieting sensitivity) of the receiver. [SINAD] [AF LEVEL SET] [MEASURE] Used for [SINAD] sensitivity measurement of the receiver.
⑤	[FM DEMO OPERATION] (FM linear detector operation indication)	This lamp lights when the FM linear detector is put into operation. When the setting of [RF FREQUENCY 25 ~ 520 MHz] of ⑭ and the transmit frequency of the transceiver coincide with each other (to within about ± 80 kHz), the red lamp lights for any of the following measurement items of [TRANSMITTER TEST]. [TRANSMITTER TEST] [RF FREQUENCY (ΔF)] [AUDIO SENSITIVITY] [AF LEVEL SET] [DISTORTION] [S/N] [TX MOD FREQUENCY]
⑥	[FREQUENCY]	Display part of frequency counter. Operation is as explained for ⑦.
⑦	[COUNTER MODE] [INPUT SELECT]	Selector switch for input signal and frequency range of frequency counter. While [EXT] lamp lights, the counter counts the signal frequency of the

No.	Name	Functional explanation
		external input terminal. When [EXT] button is depressed, the lamp goes out indicating that [INT] is selected. [10 ~ 260 Hz]: Used when the frequency under measurement is low such as tone signal. The maximum frequency which can be measured is 260 Hz. [10 Hz ~ 50 MHz]: Used when the frequency measurement is 10 Hz to 50 MHz. [50 ~ 520 MHz]: Used when the frequency under measurement is 50 to 520 MHz.
⑧	[RESOLUTION]	Switch used to set the resolution of the frequency counter. [10 ~ 260 Hz]: The resolution can be set to [10 mHz], [1 mHz] or [0.1 mHz]. [10 Hz ~ 50 MHz]: The resolution can be set to [100 Hz], [10 Hz] or [1 Hz]. The gate time is [0.1s], [1s] or [10s], respectively.
⑨	[INPUT MAX 2 Vrms]	Input connector used exclusively for the frequency counter. When [EXT] button is depressed, the lamp lights and this apparatus operates as an ordinary frequency counter. This connector can be used when the measurement item selector switch of ③ is set at any position other than [RF FREQUENCY (ΔF)] and [TX MOD FREQUENCY]. The input impedance is 1 MΩ unbalanced at [10 ~ 260 Hz] and [10 Hz ~ 50 MHz], or 50Ω unbalanced at [50 ~ 520 MHz]. It is to be noted that the maximum input level is 2 Vrms.
⑩	[OUTPUT LEVEL dBμ]	This attenuator is composed of a

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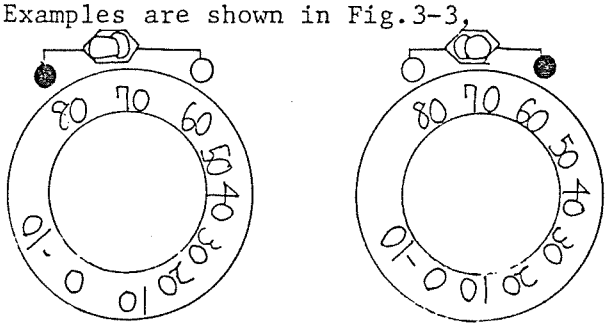
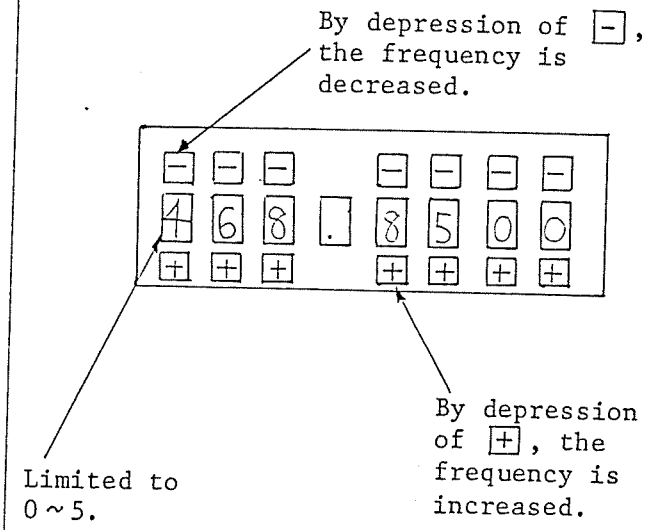
No.	Name	Functional explanation
	(RF output level variable attenuator)	toggle switch and a 70 dB attenuator which is variable in 10 dB steps. It is the output level adjuster for the RF signal generator of this apparatus. When the toggle switch is turned to the right side or left side, a green lamp lights on the side to which the switch is turned, to indicate the reading of the dial of the output adjuster. This lamp does not light when the measurement item is at [TRANSMITTER TEST]. Examples are shown in Fig.3-3,  [80 dBμ] [60 dBμ] Fig.3-3 How to read the output level attenuator
⑪	[+ 1 ~ - 10 dBμ] (RF output level continuously variable adjuster)	By varying this knob, the indication of the output level meter of ⑫ is varied and at the same time, the output level of the signal generator is varied. In interlocking with the meter indication, this knob continuously varies between + 1 and - 10 dB,
⑫	RF power meter RF output level indicator	At [TRANSMITTER TEST], the RF power is indicated, and at [RECEIVER TEST], the output level of the SG of this apparatus is indicated. The output level indication is in interlocking with the knob of ⑪ [+ 1 ~ - 10 dBμ].

No.	Name	Functional explanation
⑬	[RF POWER W] [1.5 7.5 15 30] (RF power meter range)	RF power meter ranges of 1.5, 7.5, 15 and 30W full scale.
⑭	[RF FREQUENCY 25～520 MHz] (RF frequency setting switch)	Digital switch for RF frequency setting. The RF frequency can be set in 7 digits in 100 Hz steps. There are push-buttons [+] and [−]. When the [+] button is depressed, the RF frequency is increased and when the [−] button is depressed, it is decreased. The frequency setting to the transmit or receive frequency can be done by depressing [+] and [−] buttons at 7 digits. The 100 MHz order digit is limited to 0, 1, 2, 3, 4 and 5 but 10 MHz and lower order digits can vary between 0 and 9. Carry-up and carry-down can not be done.  Fig.3-4 Operation of digital switch
⑮	Transceiver microphone connector	Connector on the right side marked with [TO TRANSCEIVER]. It is connected with the microphone input and the press-to-talk switch of the transceiver.

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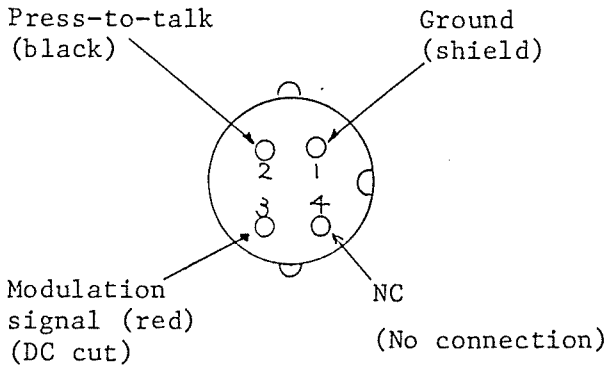
No.	Name	Functional explanation
		[LEVEL] is the level adjuster for the modulation input to tht transceiver. It is a knob with a switch. When the switch is pulled to this side, the output level is increased about 40 dB up to maximum about + 5 dBm. By means of [MOD SELECT] switch, the modulation signal is output as follows. [OFF] : Modulation signal off [1 kHz] : 1 kHz [INT] : Signal of AF OSC of (26) [1 kHz + INT]: 1 kHz [EXT + INT] : External signal [EXT] : External signal [TX (LOCK)] [RX] [TX] is a press-to-talk switch for the transceiver. [RX] is used at the receiver test of the transceiver. At [TX (LOCK)] and at [TX], the transceiver is brought into the transmitting condition. At [TX (LOCK)], the transceiver is locked in the transmitting condition. While the switch is being depressed at [TX], the transmitter keeps transmission. Moreover, at [TX (LOCK)] and at [TX], a red lamp to the right of the switch lights. The press-to-talk switch can not be turned on when the measurement item is not at [TRANSMITTER TEST]. The method of connection of the connector as viewed from the panel face is shown in Fig.3-5.

No.	Name	Functional explanation
		 Fig.3-5 Connection of microphone connector
⑯	[DEVIATION] [1, 5, 10, 20 kHz] (Deviation range)	Four deviation ranges of 1, 5, 10 and 20 kHz full scale. Used in common for the FM linear detector and the RF signal generator.
⑰	Deviation meter	Deviation meter used in common for the FM linear detector and the RF signal generator.
⑱	Deviation setting knob	Deviation setting knob marked with [MOD RATE]. Used for applying FM modulation to the RF signal generator. [INT] knob at left is for applying FM modulation by a signal from an AF oscillator. [1 kHz OR EXT] knob is for setting the deviation of 1 kHz internal modulation or external modulation signal (input at the rear). On the deviation range of ⑯, maximum of ± 20 kHz modulation can be applied.
⑲	[MOD SELECT] modulation signal selector switch	Switch marked with [OFF] [1 kHz] [INT] [1 kHz + INT] [EXT + INT] [EXT] and used for selection of AF signal for FM modulation from an RF signal generator or m crophone

No.	Name	Functional explanation
		connector of ⑮ of the transceiver. [OFF] : Modulation signal off [1 kHz]: FM modulation set by means of deviation setting knob of ⑱ by internal modulation 1 kHz is applied. [INT]: FM modulation by a frequency set by means of an AF oscillator is applied. [1 kHz + INT]: FM modation by both 1 kHz and a signal set by means of an AF oscillator is applied as system modulation. [EXT + INT]: FM modulation by both external modulation input signal and a signal from an AF oscillator is applied as system modulation. [EXT]: FM modulation by an external modulation signal only is applied.
⑳	[AF BW] (FM demodulation band selector switch)	Toggle switch connected with a filter to limit the demodulation band of the FM linear detector. It has two positions [400 Hz ~ 3 kHz] and [30 Hz ~ 3 kHz]. [400 Hz ~ 3 kHz] is used for the audio frequency band, and [30 Hz ~ 3 kHz] is used for the audio frequency band including the tone signal, etc.
㉑	[AL LEVEL METER] (AF level meter input)	Input terminal for the AF level meter. To [INPUT], external loudspeaker terminal of the transceiver, etc. can be connected using a banana plug. [600Ω] [100 kΩ] at the right is the input impedance selector switch to terminate the input with the impedance shown. In the case of 8Ω, 16Ω or the like, set the switch to [100 kΩ] and terminate the input with a required resistor. The AF level meter input can

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No.	Name	Functional explanation
		be connected when the measurement item is at [RECEIVER TEST]. At [TRANSMITTER TEST], the output of the FM linear detector is automatically connected.
㉒	AF level meter-distortion factor meter	AF level meter, also serviceable as the distortion factor meter. It has three scales of dBm, % and dB. The full scale value is selected by means of the range switch of ㉓.
㉓	AF level meter range switch	Switch marked with [LEVEL dBm DISTORTION %]. It is the range switch for the AF level meter-distortion factor meter. It has dBm, % and dB scales. The dBm scale is used to read the absolute value of the input level at [AUDIO SENSITIVITY] of [TRANSMITTER TEST] and at [AF INPUT LEVEL] of [RECEIVER TEST]. The % and dB scales are used to read relative values at the following items. [TRANSMITTER TEST] [AF LEVEL SET] [DISTORTION] [S/N] [RECEIVER TEST] [AF LEVEL SET] [DISTORTION] [S/N] [N SET] ——— [20 dB NQS] [MEASURE] ——— [AF LEVEL SET] ——— [SINAD] [MEASURE] ——— The numerical value of each range gives the full scale value of the level meter of ㉒. % in black, dBm and dB in blue.

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No.	Name	Functional explanation
㉔	Level meter full scale adjusting knob	In the distortion factor or S/N measurement, it is necessary to first make 100% or 0 dB setting. Set the range switch of ㉓ to [100%, 0 dB], and adjust the level by means of this knob so that the meter indication may be full scale. The level necessary for the full scale indication is about - 12 dBm (600Ω).
㉕	[100% SET] (Level meter full scale adjusting attenuator)	In the distortion factor of S/N measurement, [+ 10 dB] or [+ 20 dB] attenuator depending on the level of the low frequency input should be used if the level is so large that the full scale setting on [100%, 0 dB] range can not be done by means of the knob of ㉔.
㉖	[AF OSCILLATOR 50 ~ 2999 Hz] (AF oscillator frequency setting digital switch)	Digital switch for setting the frequency of the AF oscillator. The frequency can be set in 4 digits in 1 Hz steps. The switch used in the same as the RF frequency setting switch of ⑭. There are push-buttons. [+] and [-]. When the [+] button is depressed, the frequency is increased and when the [-] button is depressed, it is decreased. The 1 kHz order digit is limited to 0, 1 and 2, but 100 Hz and lower order digits can vary between 0 and 9. Carry-up and carry-down can not be done. Using this signal, FM modulation by an AF signal can be applied to the RF signal generator at [INT MOD RATE] of ⑱. Moreover, a signal is available at [AF OSC OUTPUT] of ㉙ at the rear.

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No.	Name	Functional explanation
27	[FREQUENCY RANGE] [x0.1 50 ~ 2999 Hz] [x1 50 ~ 2999 Hz]	Switch for setting the frequency range of [AF OSCILLATOR]. [x0.1 50 ~ 299.9 Hz]: Output signal of 50 to 299.9 Hz in 0.1 Hz step is obtained. [x1 50 ~ 2999 Hz]: Output signal of 50 to 2999 Hz in 1 Hz steps is obtained.

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Table 3-2 Explanation of operating controls (rear panel)

No.	Name	Functional explanation
㉘	[AF OSC] [LEVEL]	The AF signal set by means of the AF oscillator frequency setting switch of ㉖ is available at [OUTPUT] of ㉙, and the output level can be varied by means of this knob.
㉙	[OUTPUT] (AF oscillator output connector)	Output connector (BNC) for AF oscillator.
㉚	[MONITOR OUTPUT] (Monitor output connector)	Monitor terminal for the FM linear detector and the AF level meter-distortion factor meter. With an oscilloscope or the like connected to this terminal, waveform observation can be mode.
㉛	[EXT AF INPUT] (External modulation input terminal)	Jack terminal to which connection can be made using a banana plug. By connecting an external modulation signal to this terminal with the switch of ⑲ set to external modulation can be applied to the transmitter of the transceiver or the RF signal generator of this apparatus. The FM deviation can be set by means of [MOD RATE] [1 KHz OR EXT] of ⑱.
㉜	[EXT SPAKER] [OUTPUT]	Terminal for external loudspeaker output for voice monitoring. With a loudspeaker connected to this terminal, [MONITOR OUTPUT] of ㉚ can be confirmed in terms of voice signal.
㉝	[RF OUTPUT (- 40 dB)] (RF output connector)	Connector (BNC). When the measurement item in the transmitter test of the transceiver is set at [OUTPUT (REAR)] of [TRANSMITTER TEST], a signal which is 40 dB down (1/10000 in power) from the

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No.	Name	Functional explanation
		input power is available. To this connector, a spectrum analyer or the like may be connected for spurious measurement, etc. of the transceiver. Example: 30W (about + 44.8 dBm) → 3 mW (about + 4.8 dBm) 5W (+ 37 dBm) → 0.5 mW (- 3 dBm) 1W (+ 30 dBm) → 0.1 mW (- 10 dBm)
㉞	[10 MHz OUTPUT]	The output of the reference signal oscillator used as the synthesizer of this apparatus is available here. 10 MHz ± 0.1 x 10^{-6}
㉟	[REMOTE]	Connector for remote control of the frequency variation of [RF GENERATOR 25 ~ 520 MHz] and [AF OSCILLATOR 50 ~ 2999 Hz] of this apparatus. For the details, refer to Paragraph 3.5.8 "Remote control".
㊱	[G]	Ground terminal of this apparatus. Be sure to connect this terminal to ground when using this apparatus.
㊲	AC power connector	IEC type connector consisting of a power fuse and a printed circuit board for switching voltage connections. For the details, refer to Paragraph 3.4.1 "Power supply".

Fig. 3-1 TYPE AH-5403 RADIO TELEPHONE TESTER

FRONT PANEL

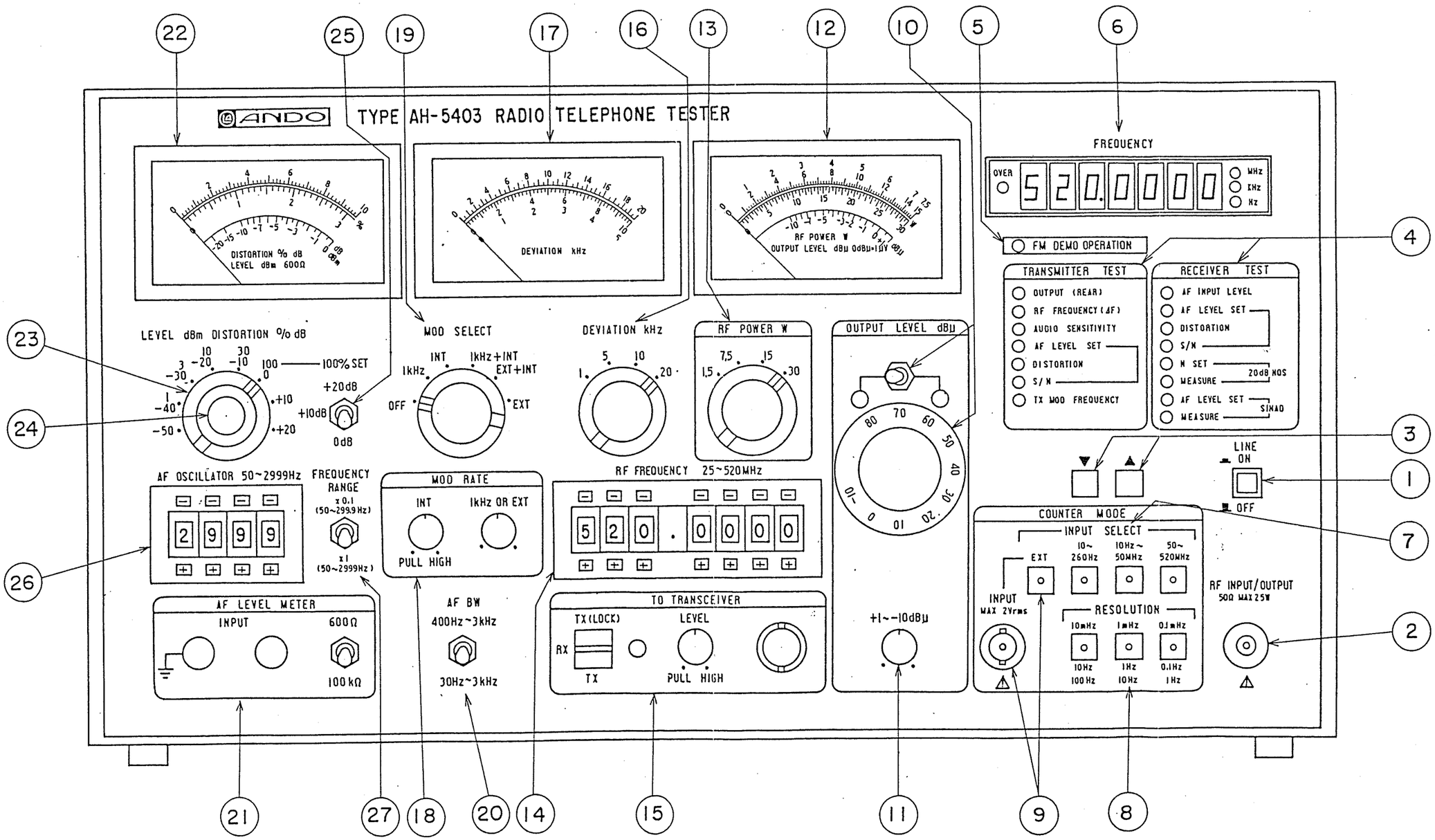
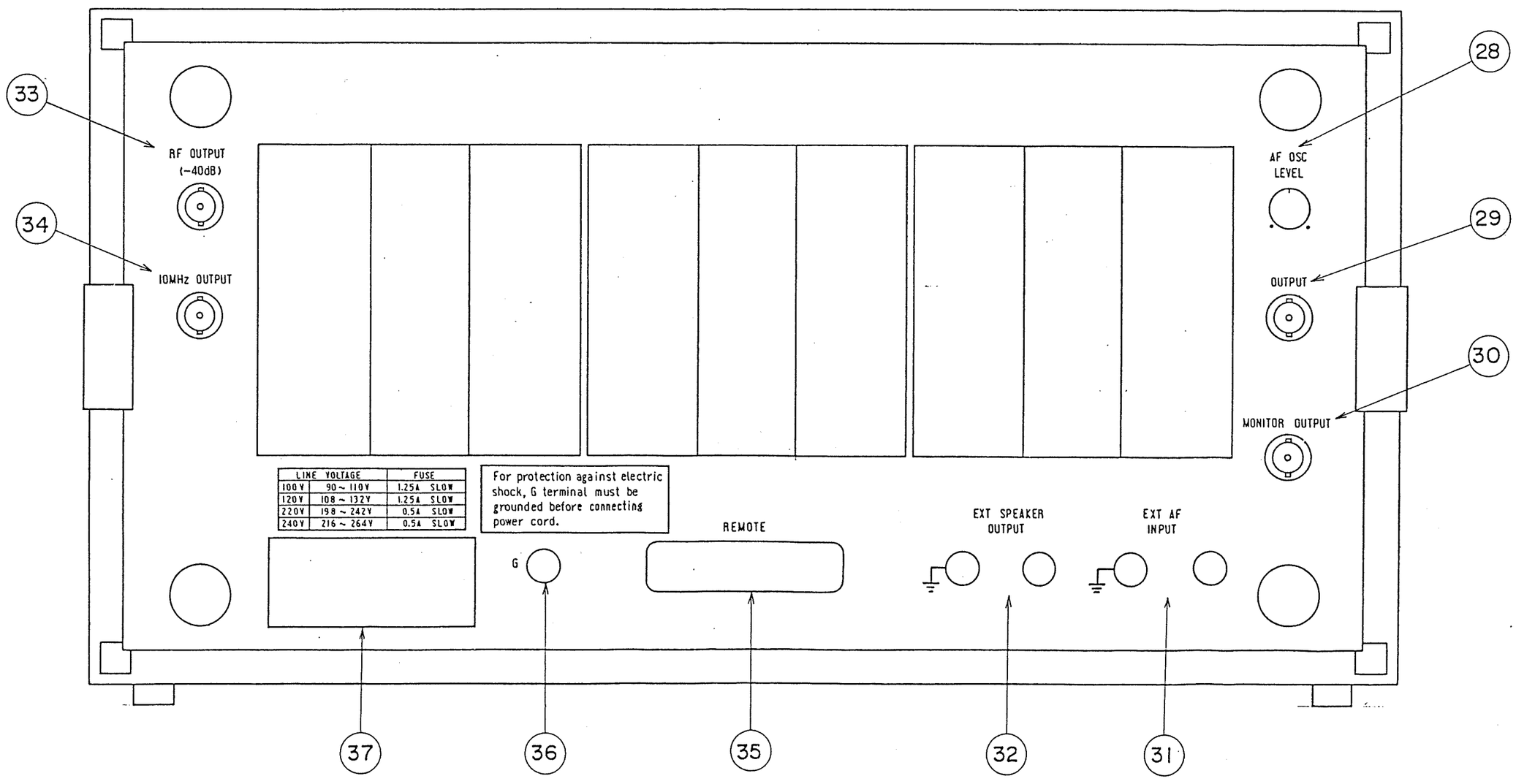


Fig. 3-2 TYPE AH-5403 RADIO TELEPHONE TESTER

REAR PANEL



3.3 Precautions

(1) The RF input/output circuit of this apparatus is not DC cut. Any apparatus in which a DC current is superposed, therefore, should be DC cut before it is connected to this apparatus.

(2) This apparatus is given considerations to have good characteristics ro microphonics. However, it should be installed and used in a place which is as quiet as possible, because vibrations or large noises, if existing, may cause the S/N ratio, etc. to be degraded.

(3) The output level of the RF signal generator of this apparatus in dBμ is specified in terms of the open voltage. When the output is terminated with a 50Ω load, it is necessary to subtrate 6 dB from the reading of [OUTPUT LEVEL] of this apparatus to obtain the actual output level.

(4) When using this apparatus and other apparatus as piled one on the other, it is to be noted that the S/N ratio may be degraded under influences of leakage magnetic fields of the power transformer, etc.

(5) This apparatus should be used in the stable condition after lapse of about 15 minutes (at 5° to 35°C) from the time power supply is turned on.

(6) When checking the interior of this apparatus with power applied to the apparatus, care should be taken not to short-circuit any circuit of this apparatus. If the circuit is short-circuited, parts such as IC, transistor, diode, etc. may be damaged.

(7) When moving this apparatus, for example, by transportion on an automobile, care is necessary, like in handling other measuring instruments, not to give strong impacts.

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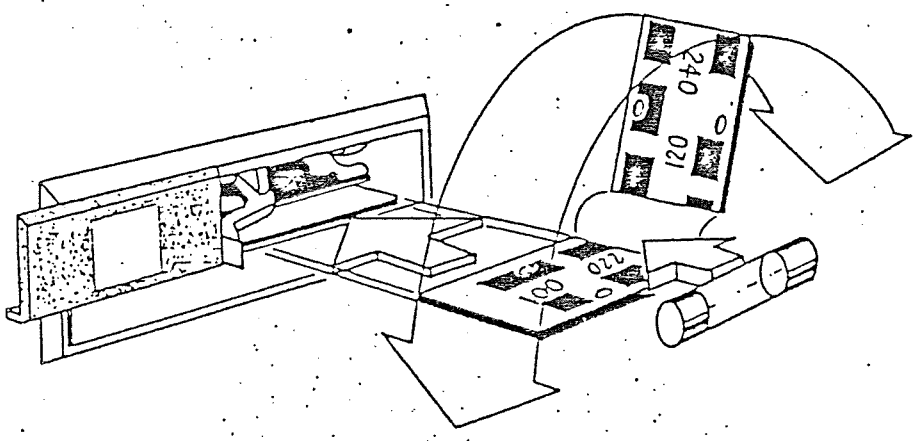
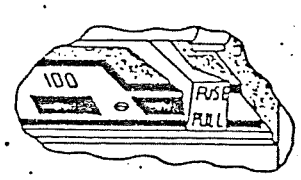
3.4 Preparation

3.4.1 Power supply

This apparatus can be operated with an AC power source of 90 to 132V or 198 to 264V, 48 to 63 Hz. The operating voltage can be set by changing the direction of insertion of the printed circuit board as shown in Fig.3-6. The fuse corresponding to each operating voltage is shown in Table 3-3.



The operating voltage is indicated in the window of the power supply module.



How to set the operating voltage

1. Open the cover (window), pull [FUSE PULL] lever, remove the fuse and place the lever at the left end position.
2. Set the operating voltage by inserting the printed circuit board in such a direction that the mark of the desired voltage value appears on the upper left portion of the printed circuit board. The printed circuit board should be secured in that direction in the power supply module.
3. Return [FUSE PULL] level to the normal position and insert a fuse in accordance with Table 3-3.

Fig.3-6 How to set the operating voltage

Table 3-3

Operating voltage	Printed circuit board in the power supply module	AC power fuse
90 to 110V	[100] mark appears.	1.25A slow-blow
108 to 132V	[120] mark appears.	1.25A slow-blow
198 to 242V	[220] mark appears.	0.5A slow-blow
218 to 264A	[240] mark appears.	0.5A slow-blow

3.4.2 Mechanical zero adjustment of the meter

Before turning on power supply to this apparatus, confirm that the pointer of each of three meters on the panel is at the zero position on the scale. If it is not, zero adjustment should be made as follows.

Turning the zero adjustment screw of the meter clockwise causes the poitner to deflect to right, and counterclockwise turning causes it to deflect to left. Turn the zero adjustment screw clockwise or counterclockwise so that the pointer may come to the zero position. When the pointer is just at the zero position, turn it slightly back to adjust the tension of the suspension to a proper value.

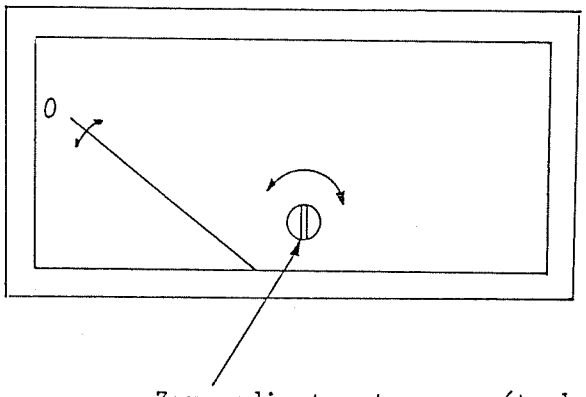


Fig.3-7 Method of mechancial zero adjustment of the meter

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3.4.3 Preliminary procedure

(1) Before turning on power supply to this apparatus, set the operating knobs and dials as follows.

[LINE] switch	[OFF]
[OUTPUT LEVEL] switch	Right side
[OUTPUT LEVEL] dial	Fully clockwise
[+ 1 ~ - 10 dBμ]	Center
[RF POWER W] switch	[30]
[DEVIATION kHz] switch	[20]
[RF FREQUENCY 25 ~ 520 MHz]	Any frequency between 25 and 520 MHz
[TO TRANSCEIVER] swirch	[RX]
[LEVEL] knob	Fully counterclockwise (PUSH)
[MOD RATE] [1 kHz OR EXT] knob	Fully counterclocksiwe
[INT] knob	Fully counterclockwise (PUSH)
[MOD SELECT] switch	[OFF]
[AF BW] switch	[400 Hz ~ 3 kHz]
[100% SET] switch	[+ 20 dB]
[LEVEL dBm DISTORTION % dB] switch	[0 dB, 100%]
[AF OSCILLATOR 50 ~ 2999 Hz]	Any frequency between 50 and 2999 Hz
[FREQUENCY RANGE]	[x1]
[AF LEVEL METER] awirch	[600Ω]

(2) Connect the power cord to the 50/60 Hz line of the specified voltage.

(3) Depress [LINE] switch to [ON], and [OUTPUT (- 40 dB)] lamp of [TRANSMITTER TEST] will light to indicate that power is applied to this apparatus, and this apparatus will be in operation.

3.5 Operation

In the following, descriptions will be given with emphasis on using this apparatus as a single measuring unit. For using this apparatus for the measurement or adjustment of the transceiver, refer to SECTION 4. The descriptions assume that the preparation in 3.4.3 is completed and power is applied to this apparatus.

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3.5.1 RF power meter-frequency counter

When using this apparatus as the RF power meter-frequency counter, operate it by the following procedure in accordance with Fig.3-8.

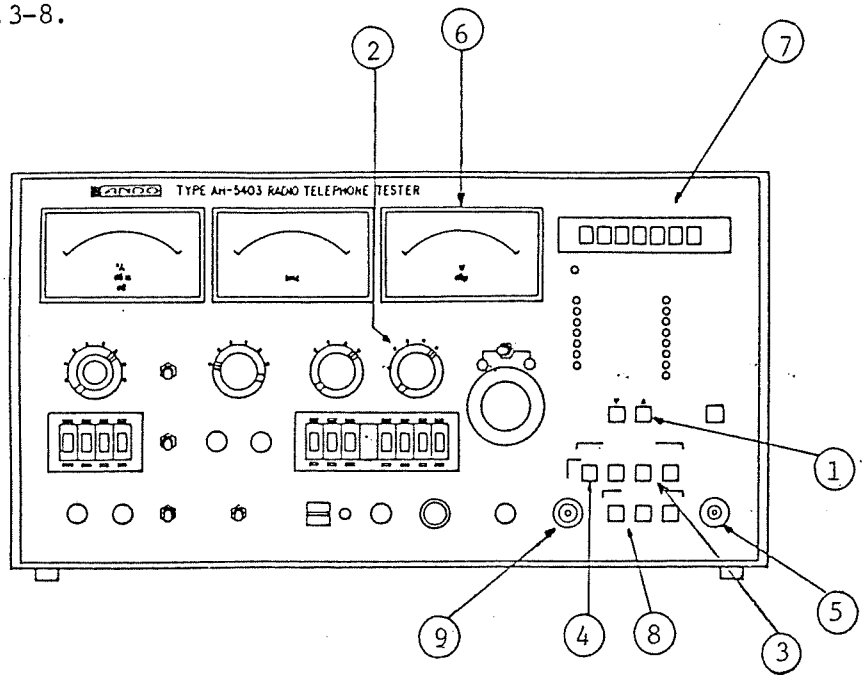

Fig.3-8 Operation as the RF power meter-frequency counter

(1) Depress ▼ or ▲ button of ① to set the measurement item to [OUTPUT (REAR)] of [TRANSMITTER TEST].

(2) Set [RF POWER W] range of ② to [30].

(3) Set [INPUT SELECT] of [COUNTER MODE] to [10 Hz ~ 50 MHz] or [50 ~ 520 MHz] of ③.

NOTE: If [EXT] lamp of ④ lights, it is allowed to go out by depressing [EXT] button, and switching to [INT] is done.

(4) Connect the apparatus under measurement to [RF INPUT/OUTPUT 50Ω MAX. 25W] of 5 .

(5) The RF power meter of ⑥ will give an indication corresponding to the power. Set [RF POWER W] range of ② according to the power.

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3.5.2 Frequency counter

When using this apparatus as the ordinary frequency counter, operate it by the following procedure in accordance with Fig.3-9.

NOTE	For the frequency measurement of any signal source which provides several Watts like the transmitter of the transceiver, use the procedure of 3.5.1 "RF power meter-frequency counter". The input level range in the measurement of 3.5.2 is maximum 2 Vrms (+ 19 dBm, about 0.1W).

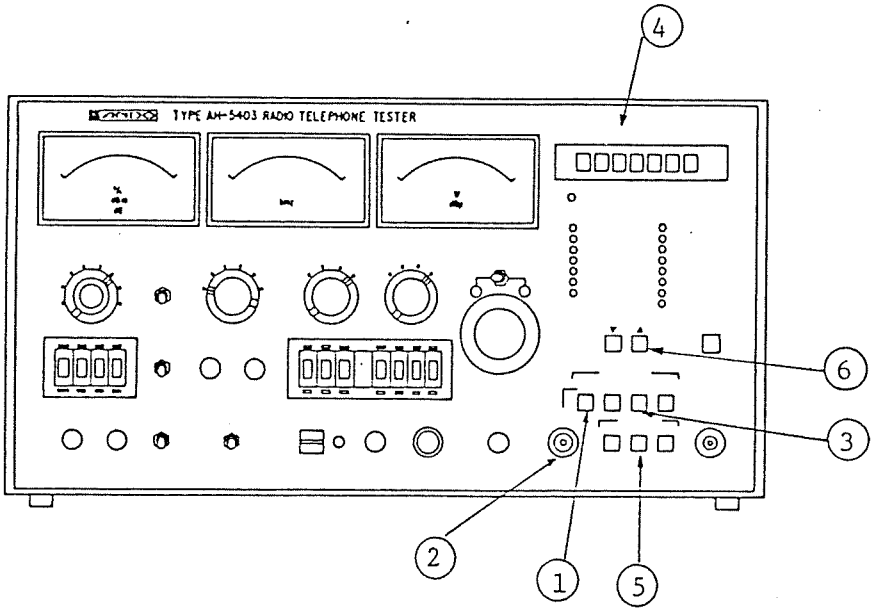

Fig.3-9 Operation as the frequency counter

(1) Depress [EXT] of ① of [INPUT SELECT] switch of [COUNTER MODE]. The lamp at the buttom lights to indicate that the frequency counter operates with an external input.

(2) Connect the signal under measurement to [INPUT] of ②.

NOTE	The maximum input level is 2 Vrms (+ 19 dBm).

(3) Depending on the input frequency, select the range by means of the button of ③.

(4) The input frequency is displayed on [FREQUENCY] of ④.

(5) Set [RESOLUTION] of ⑤ to the digit (resolution) of measurement.

NOTE	When use at [EXT] measurment, set the measurement item selector switch of ⑥ to any position other than [RF FREQUENCY (ΔF)] and [TX MOD FREQUENCY].

3.5.3 AF oscillator

When using this apparatus as the AF oscillator, operate it by the following procedure in accordance with Fig.3-10.

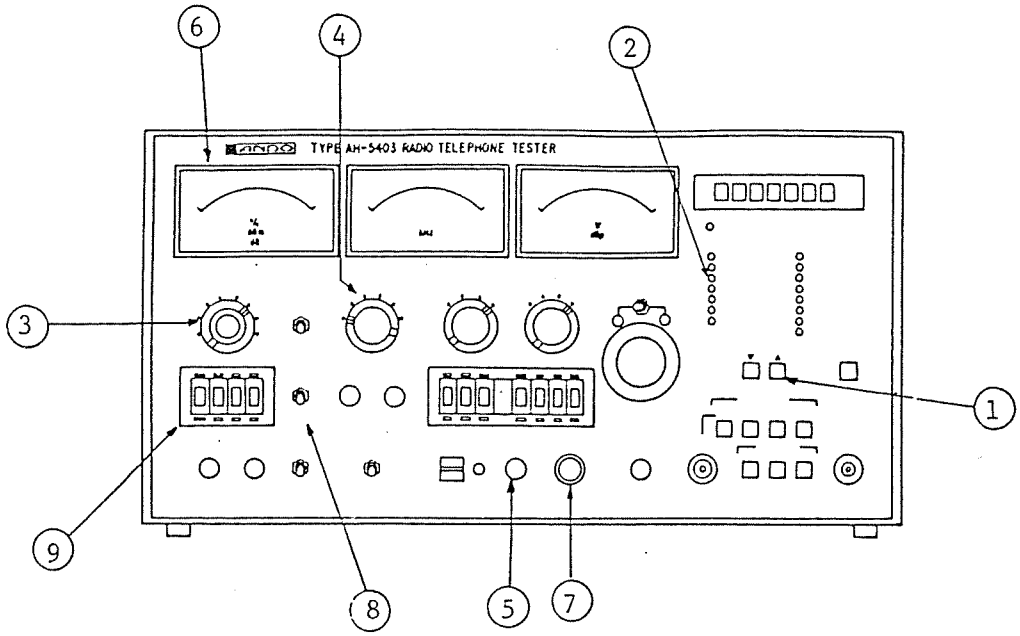

Fig.3-10 Operation as the AF oscillator

(1) Depress [▼] or [▲] button of ① to set the measurement item to [AUDIO SENSITIVITY] of ②.

(2) Set [LEVEL dBm] range of ③ to [+ 20 dBm].

(3) Turn [MOD SELECT] switch to [1 kHz].

(4) Pull [LEVEL (HIGH)] knob of ⑤ and turn it clockwise, and the level meter of ⑥ will deflect and indicate an output level of 1 kHz.

(5) The output signal of 1 kHz is available at the microphone connector of ⑦.

The connection of the microphone connector of ⑦ as viewed from the panel from is shown in Fig.3-11.

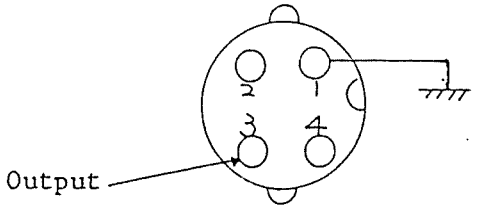

Fig.3-11 Output connection of the AF oscillator

(6) Set [MOD SELECT] of ④ to [INT], and an AF signal of the frequency set by means of [FREQUENCY RANGE] of ⑧ and [AF OSCILLATOR] of ⑨ is output.

NOTE	The frequency of [AF OSCILLATOR] is as follows. RANGE [x0.1] 50.0 to 299.9 Hz in 0.1 Hz steps [x1] 50 to 2999 Hz in 1 Hz steps

NOTE	The maximum output level varies with the load impedance to be connected and is about + 5 dBm (about 1.4V) into a resistance load of 600Ω.

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3.5.4 FM linear detector

When using this apparatus as the FM linear detector, operate it by the following procedure in accordance with Fig.3-12.

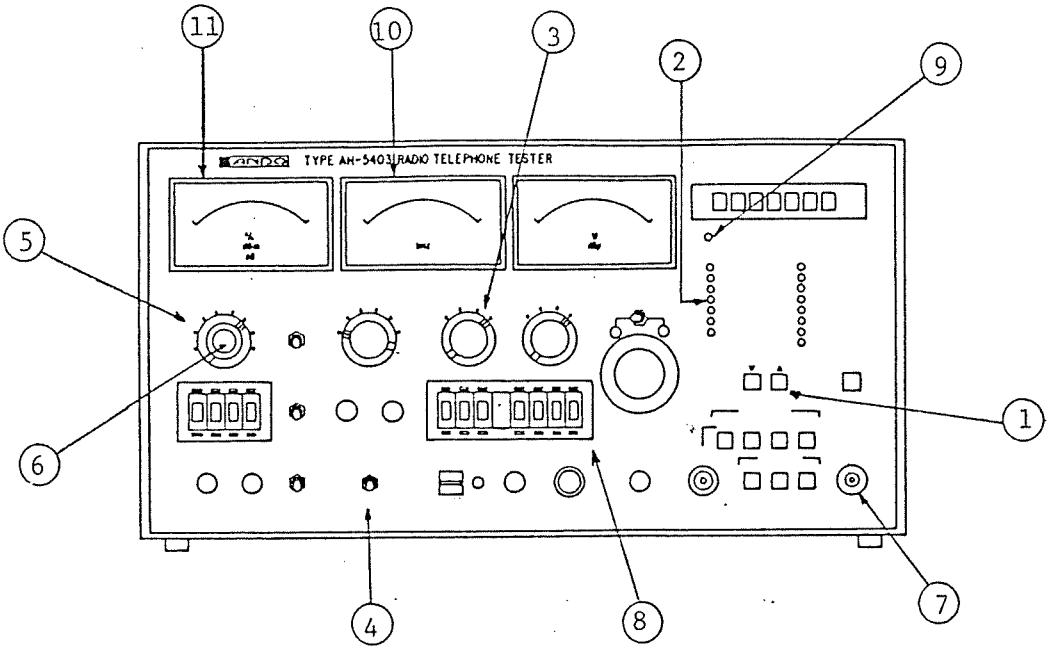

Fig.3-12 Operation as the FM linear detector

(1) Depress [▼] or [▲] button of ① to set the measurement item to [AF LEVEL SET] of ②.

(2) Set [DEVIATION kHz] range switch of ③ to [20].

(3) Set [AF BW] switch of ④ to [400 Hz ~ 3 kHz].

(4) Set [LEVEL] meter range of ⑤ to [0 dB].

(5) Turn [LEVEL] adjustment knob of ⑥ fully counterclockwise.

(6) Connect the signal under measurement to [RF INPUT/OUTPUT 50Ω MAX. 25W] of ⑦.

(7) Depress [+] or [−] button of [RF FREQUENCY 25 ~ 520 MHz] frequency setting switch of ⑧ to set the frequency to the input signal frequency.

(8) [FM DEMO OPERATION] red lamp of ⑨ lights to indicate that the FM linear detector is in operation.

(9) The deviation meter of ⑩ indicates the deviation. According to the magnitude of the deviation, set [DEVIATION kHz] range switch of ③.

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NOTE	On the deviation range of 1 kHz/full scalle, only the deviation of any modulation signal of 500 Hz or lower such as the tone signal can be measured.

(10) At the same time that the deviation meter of ⑩ deflects, the level meter of ⑪ deflects. Using the knob of ⑥, set the deflection to the full scale.

(11) Turn off the modulation of the input signal, and the S/N can be measured. When the modulation is turned off, the indication of the deviation meter of ⑩ lowers and the indication of the level meter of ⑪ also lowers. Turn the range switch of ⑤ of the level meter counterclockwise until the deflection of the level meter of ⑪ comes to a position for easy reading on the meter.

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3.5.5 RF signal generator

When using this apparatus as the RF signal generator, operate it by the following procedure in accordance with Fig.3-13.

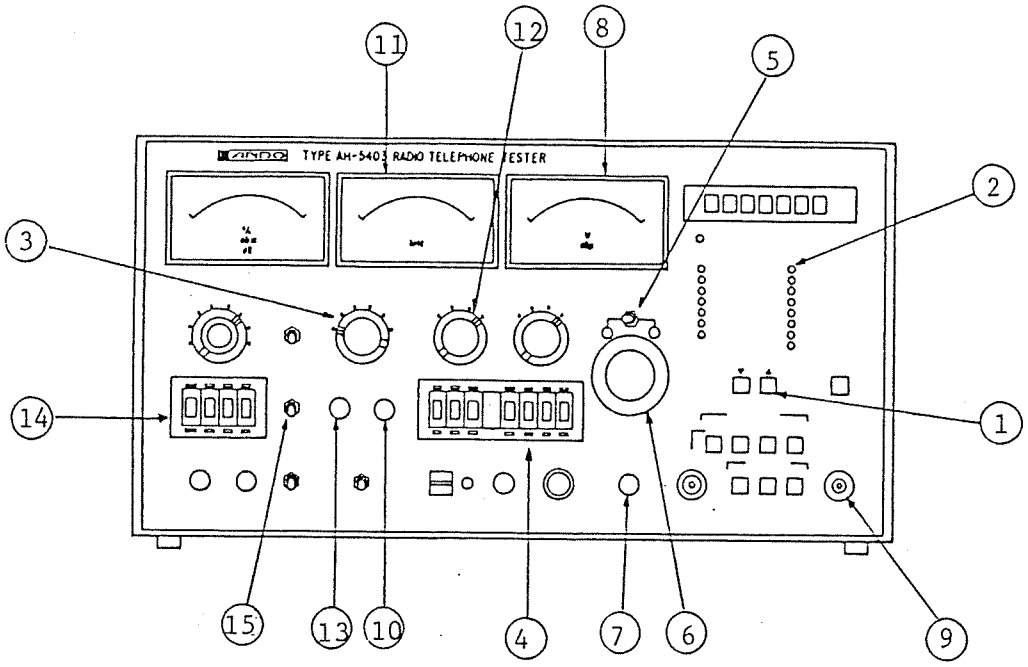


Fig.3-13 Operation as the RF signal generator

3.5.5.1 Method of generating a CW (unmodulated) signal

(1) Depress [▼] or [▲] button of ① to set the measurement item to [AF INPUT LEVEL] of ②.

(2) Set [MOD SELECT] switch of ③ to [OFF].

(3) Depress [+] or [−] button of [RF FREQUENCY 25 ~ 520 MHz] frequency setting switch of ④ to set the frequency to the desired value. The frequency is increased by depressing the [+] button located below and is decreased by depressing the [−] button located above.

(4) The output level can be varied in 10 dB steps by means of the toggle switch of ⑤ and the dial of ⑥ of [OUTPUT LEVEL dBμ]. Further, it can be continuously varied in the range of 11 dB (from + 1 to − 10 dB) by means of [+ 1 ~ 10 dBμ] knob of ⑤. The continuously variable level is indicated on the level meter of ⑧, and the sum of the meter indication and the indication of the dial of ⑥ gives the output level being sought.

[How to read the output level]

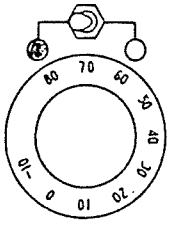
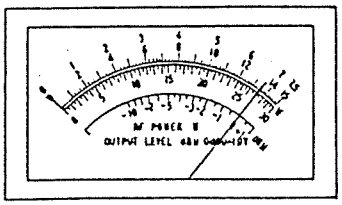
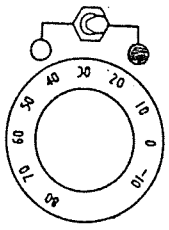
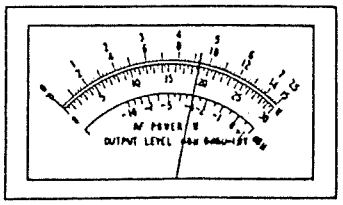
(1) If an output level in a range from - 10 to + 60 dBμ is to be obtained, turn the toggle switch of (5) to the right side.

(2) If an output level in a range from + 10 to + 80 dBμ is to be obtained, turn the toggle switch of (5) to the left side.

(3) On the side to which the toggle switch of (5) is turned, a green lamp lights to indicate the reading of the dial of (6). (Refer to Fig.3-3.)

NOTE: The green lamp lights only when the measurement item is at [RECEIVER TEST]. At [TRANSMITTER TEST], both lamps go out.

(4) Some examples of level reading are shown below.

	Reading of the dial		Reading of the meter		
(a)					
	80 dBμ	+	- 0 dBμ	=	80 dBμ
(b)					
	20 dBμ	+	(- 3 dBμ)	=	- 5 dBμ

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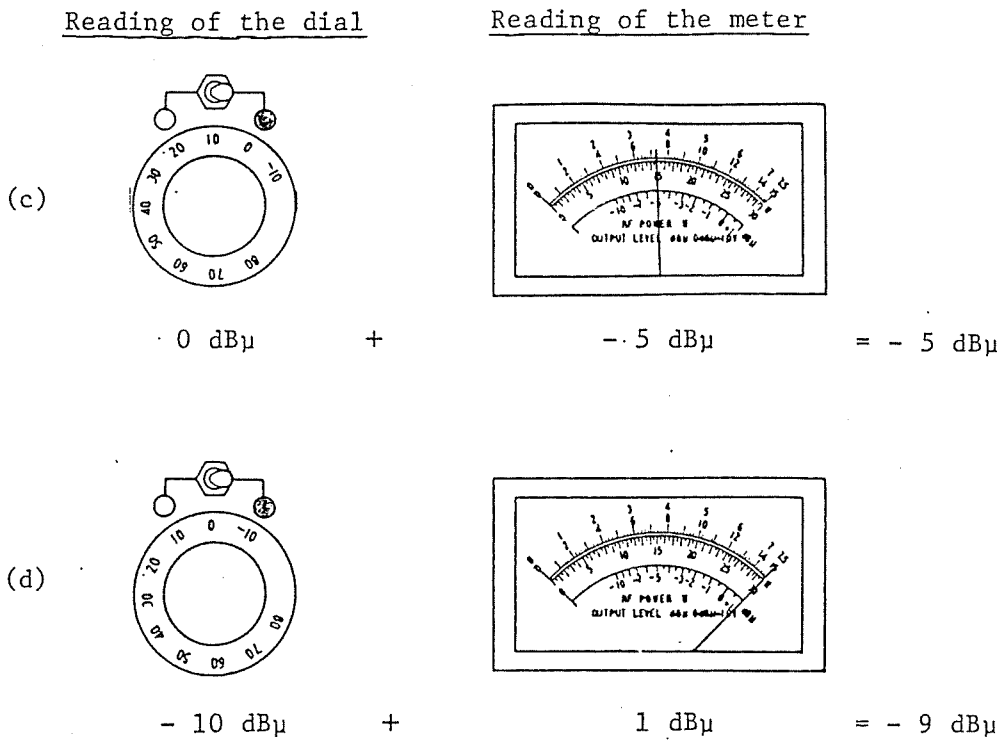

Fig.3-14 How to read the output level

(7) A signal of the frequency and output level set at mentioned above is available at [RF INPUT/OUTPUT 50Ω MAX. 25W] of ⑨.

3.5.5.2 How to apply internal modulation (1 kHz)

(1) In the condition in which this apparatus is in operation with the CW (unmodulated) signal as mentioned above, turn [MOD SELECT] switch of ③ to [1 kHz].

(2) Turn [1 kHz OR EXT] knob of ⑩ clockwise, and an RF signal which has been FM modulated with an internally generated 1 kHz signal will be generated.

(3) The deviation at that time is indicated on the deviation meter of ⑪. The FM modulation signal with a maximum of ± 20 kHz deviation applied by means of [DEVIATION kHz] range of ⑫ is available.

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3.5.5.3 How to apply FM modulation with an AF signal

(1) Turn [MOD SELECT] switch of ③ to [INT].

(2) Depress [+] or [−] button of [AF OSCILLATOR 50∼2999 Hz] AF signal frequency setting switch of ⑭ to set the frequency to the required AF signal frequency.

(3) Turn [INT] knob of ⑬ clockwise to apply FM modulation with an AF signal.

(4) Pull [INT] knob and turn it, deviations of maximum ±20 KHz can be applied by means of [DEVIATION KHz] range of ⑫.

3.5.5.4 How to apply system modulation

(1) The system modulation means simultaneous modulation with an audio frequency signal (of 1 kHz in the case of internal modulation or 400 Hz to 3 kHz in the case of external modulation) and a tone signal.

(2) Set [MOD SELECT] switch of ③ to [INT].

(3) Set [AF OSCILLATOR 50∼2999 Hz] of ⑭ and [RANGE] of ⑮ to the desired tone frequency.

(4) Set [DIVIATION kHz] of ⑫ to [1 kHz], and turn [INT] knob of ⑬ to apply 500 Hz FM modulation.

(5) Set [DEVIATION kHz] range of ⑫ to [5 kHz] or [10 kHz].

(6) Turn [MOD SELECT] switch of ③ to [1 kHz + INT].

(7) While reading the deviation meter of ⑪, turn [1 kHz OR EXT] knob of ⑩ to set the deviation to the required value. (The deviation in total of audio signal modulation and tone signal modulation is indicated.)

NOTE: The tone signal is used mainly in the transceiver for simple service. It is not permitted that the deviation in total of tone signal modulation and audio signal modulation should exceed ± 5 kHz (maximum frequency deviation).

3.5.5.5 How to apply external modulation

(1) Connect a low frequency oscillator to [EXT AF INPUT] provided at the rear.

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NOTE: For FM modulation of ± 20 kHz, about 1 Vrms is necessary.

(2) Set [MOD SELECT] switch of ③ to [EXT].

(3) By turning [1 kHz OR EXT] knob of ⑩ clockwise, FM modulation can be applied.

NOTE: The deviation in the FM modulation is indicated on the deviation meter of ⑪ .

(4) For applying system modulation using a tone signal, set [MOD SELECT] switch of ③ to [INT] and apply 500 Hz FM modulation similarly to 3.5.5.4, then turn the same switch to [EXT + INT] and adjust [1 kHz OR EXT] knob of ⑩ so that standard modulation is obtained.

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3.5.6 Low frequency (AF) level meter

When using this apparatus as the AF level meter, operate it by the following procedure in accordance with Fig.3-15.

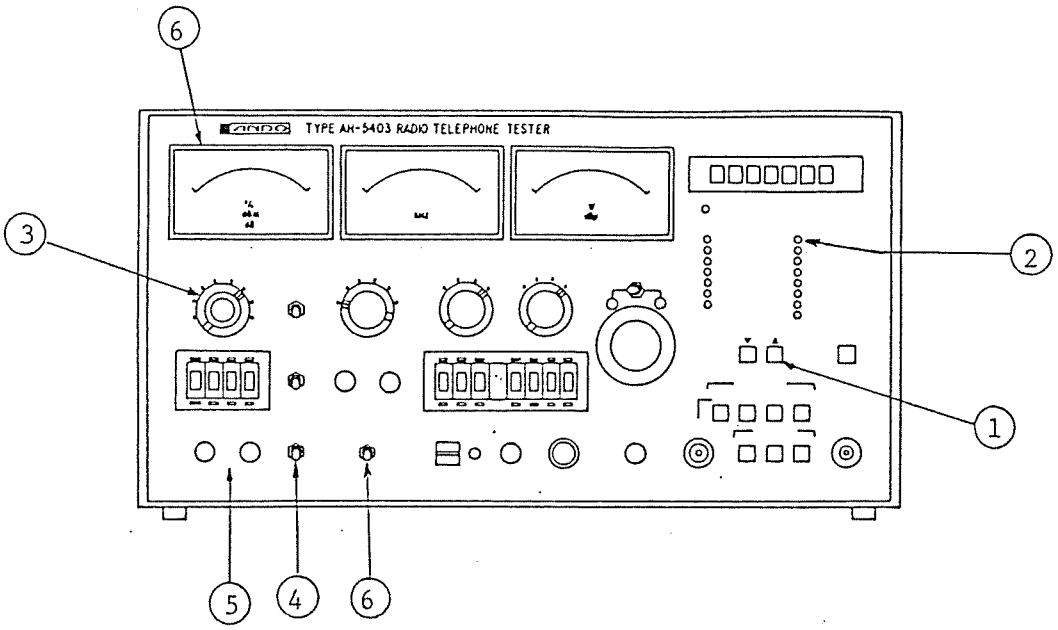

Fig.3-15 Operation as the AF level meter

(1) Depress [▼] or [▲] button of (1) to set the measurement item to [AF INPUT LEVEL] of [RECEIVER TEST] of (2).

(2) Set [LEVEL dBm] range switch of (3) to [+ 20 dBm].

(3) Set the switch of (4) to either [600Ω] or [100 kΩ] appropriately for the impedance of the apparatus under measurement.

NOTE:	For measurement with the output terminated with 4Ω, 8Ω, 16Ω or the like, set the switch of (4) to [600Ω] or [100 kΩ], and connect a necessary resistor to [INPUT].

(4) Connect the signal under measuremet to [AF LEVEL METER INPUT] of (5).

(5) The input level is indicated on the AF level meter of (6).

(6) Adjust the range switch of (3) so that the indication of the level meter may be easy to read.

NOTES:

(1) The frequency range of the AF level meter is from 30 Hz to 10 kHz. Also, set [AF BW] switch of ⑥ to [400 Hz ~ 3 kHz], and the frequency range of the AF level meter becomes from 400 Hz to 10 kHz.

(2) The level meter is graduated in dBm (600Ω). 0 dBm (600Ω) is 0.775V rms. (For the dBm (600Ω) vs. voltage relations, the method for obtaining power from voltage and impedance, etc., refer to the reference data given in SECTION 5.)

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3.5.7 Distrotion factor meter

When using this apparatus as the distortion factor meter, operate it by the following procedure in accordance with Fig.3-16.

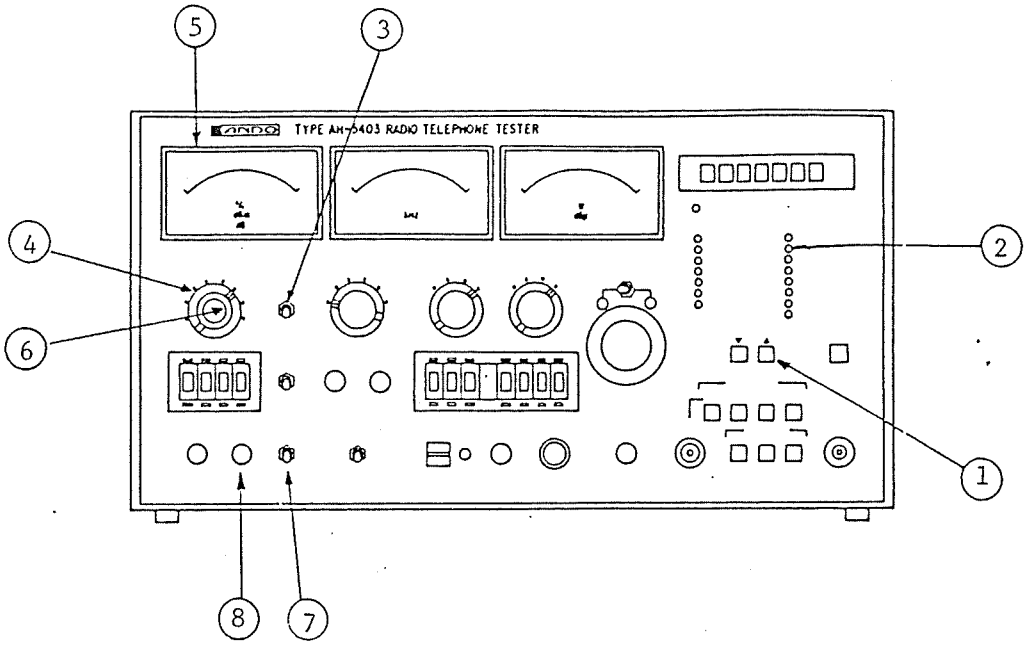

Fig.3-16 Operation as the distortion factor meter

NOTE: The measuring frequency for the distortion factor meter of this apparatus is 1 kHz ± 10 Hz. Use internal 1 kHz, or in the case of an external signal source, use a signal within 1 kHz ± 10 Hz for the measurement.

(1) Depress [▼] or [▲] button of (1) to set the measurement item to [AF LEVEL SET] of (2).

(2) Set [100% SET] switch of (3) to [+ 20 dB].

(3) Set [DISTORTION % dB] range switch of (4) to [100%, 0 dB].

NOTE: For the measurement item at [AF LEVEL SET] of (2), the AF level meter of (5) does not deflect with [DISTORTION % dB] range switch of (4) at [+ 10 dB] or [+ 20 dB]. It is necessary to use [100%, 0 dB] range.

(4) Turn the level varying knob of ⑥ fully counterclockwise.
(5) Set the switch of ⑦ to [600Ω] or [100 kΩ] appropriately for the impedance of the apparatus under measurement.

NOTE:	When terminating the output with 4Ω, 8Ω, 16Ω or the like, set the swhich of ⑦ to [100 kΩ] and connect a necessary resistor to [AF LEVEL METER INPUT] of ⑧.

(6) Connect the signal under measurement to [AF METER INPUT] of ⑧.
(7) The AF level meter of ⑤ will deflect with the input level. Turn the level varying knob of ⑥ clockwise to set the AF level meter for full scale indication.
(8) If it is impossible to set the AF level meter for full scale indication by means of the level varying knob of ⑥ alone, set [100% SET] switch of ③ to [+ 10 dB] or [0 dB] appropriately for the input level and again adjust the level varying knob of ⑥ for full scale indication.

NOTE :	The level varying knob of ⑥ has a variable range of about 13 dB.

NOTES: Guides for setting [100% SET] switch of ③
(1) If the level measured with [AF INPUT LEVEL] (refer to 3.5.6) is less than 0 dBm, set this switch to [0 dB]. The minimum input level for full scale indication is about - 12 dBm (about 0.2V).
(2) If the input level is between + 1 and + 10 dBm, set this switch to [+ 10 dB].
(3) If the input level is between + 11 and + 20 dBm, set this switch to [+ 20 dB].

(9) After full scale indication is obtained, depress [▼] button of ① to set the measurement item to [DISTORTION].
(10) Automatically the fundamental eliminating circuit of 1 kHz ± 10 Hz operates and the distortion factor is indicated on the AF level meter of ⑥.

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(11) Turn [DISTORTION % dB] range of (4) counterclockwise until the meter indication is easy to read.

NOTE:	At this time, do not tamper with the level varying knob of (6), otherwise the 100% (0 dB) set level is deviated and correct distortion factor measurement can not be made.

3.5.8 Remote control

Remote control with an external signal can be applied to RF frequency ([RF FREQUENCY 25∼520 MHz]) and AF frequency ([AF OSCILLATOR 50∼2999 Hz]) of this apparatus, as explained below.

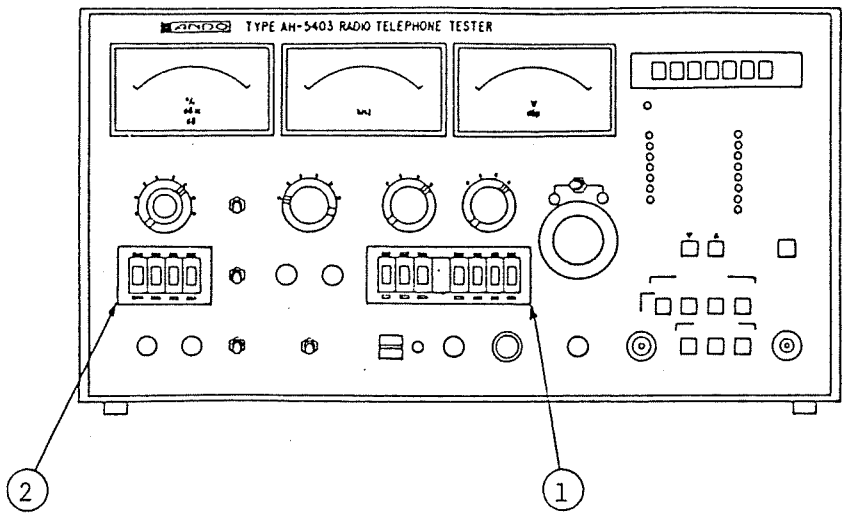

Fig.3-17 Remote control

(1) Set all digital switches of [RF FREQUENCY 25∼520 MHz] of ① and [AF OSCILLATOR 50∼2999 Hz] of ② to [0], and the remote control operation can be done.

(2) The connecting connector for remote control is provided on the rear panel. It is 57-40500 of DAIICHI DENSHI KOGYO. The compatible connector is 57-30500 of the same manufacturer. (It is equivalent to that the same designation of ANPHENOL and is interchangeable thereto.)

(3) For the connector terminal connection vs. signal relation, refer to Fig.3-18.

(4) The control signal is a binary coded decimal code (BCD) of negative logic TTL level. For each digit of the frequency, it is applied to the terminal of Fig.3-18.

(5) Numbers 0 to 9, as expressed in BCD of negative lobic, are shown in Table 3-4.

(6) For resuming the manual operation mode, remove the connecting connector for remote control.

Table 3-4

BCD	2^0(1)	2^1(2)	2^2(4)	2^3(8)
0	H	H	H	H
1	L	H	H	H
2	H	L	H	H
3	L	L	H	H
4	H	H	L	H
5	L	H	L	H
6	H	L	L	H
7	L	L	L	H
8	H	H	H	L
9	L	H	H	L

H: High level (open or + 2.8 to + 5V in the case of this apparatus)
L: Low level (0 to + 0.8V in case of this apparatus)

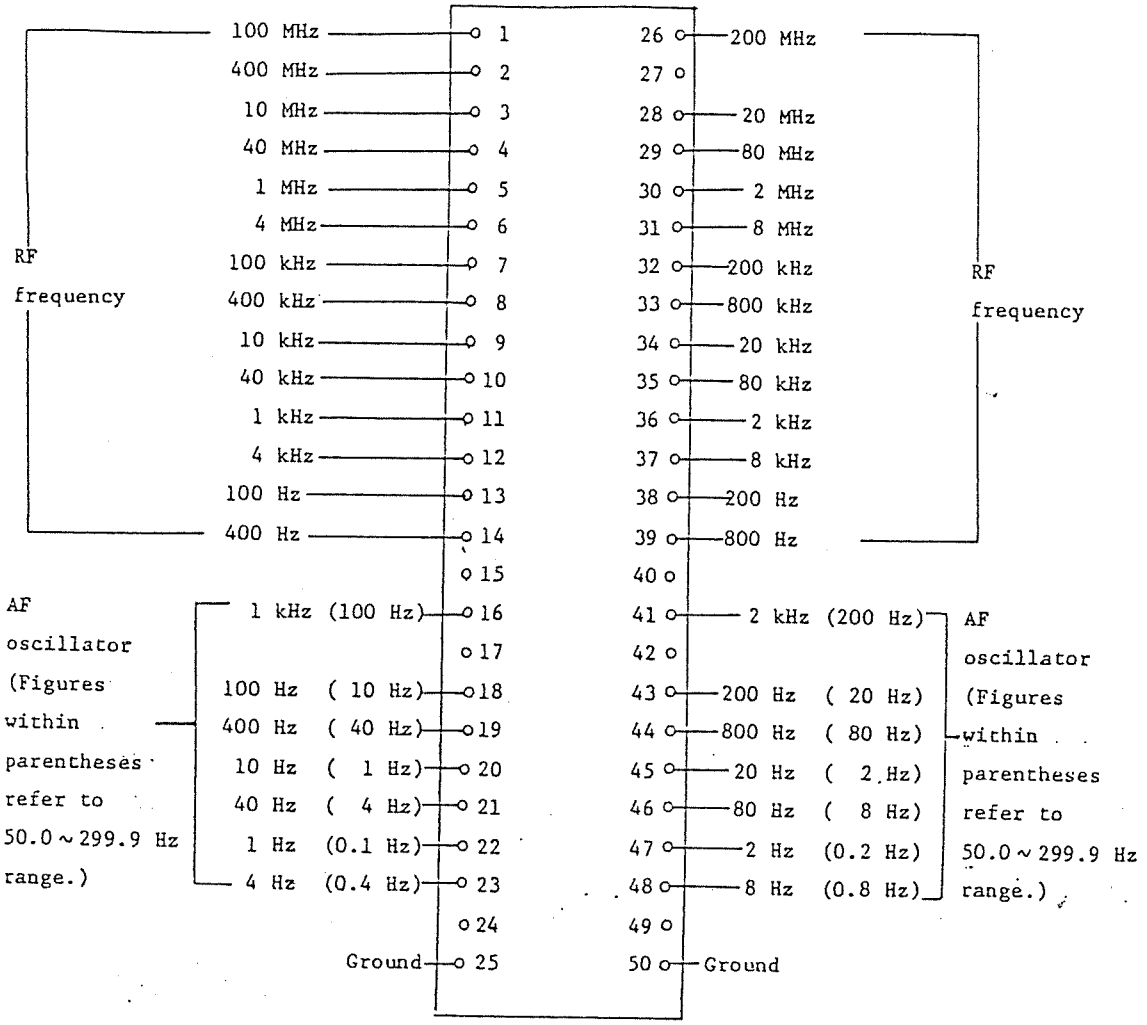

Fig.3-18 Terminal connection for remote control

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Examples of use for frequency setting by remote control are shown below.

(1) [RF FREQUENCY 25~520 MHz]

For example, for setting to 468.850 MHz, set the following terminals to L and others to H.

Terminals to be set to L	Set frequency
2	400 MHz
4 and 28	60 MHz
31	8 MHz
33	800 kHz
9 and 10	50 kHz

NOTE: The frequency range by remote control is 25 to 520 MHz. Outside of this range, this equipment may operate erroneously. The connector for remote control of this apparatus and [RF FREQUENCY 25~520 MHz] digital switch on the front panel are connected in parallel. Therefore, if the digital switch is operated with the remote control terminal connected, setting to the correct frequency can not be done.

(2) [AF OSCILLATOR 50~2999 Hz]

For axample, for setting to 2503 Hz (250.3 Hz by means of the range switch), set the following terminals to L and others to H.

Terminals to be set to L	Set frequency
41	2 kHz (200 Hz)
18 and 19	500 Hz (50 Hz)
22 and 47	3 Hz (0.3 Hz)

NOTE: The frequency range by remote control is 50 to 2999 Hz (50.0 to 299.9 Hz by means of the range switch). Outside of this range, this apparatus

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may operate erroneously. The connector for remote control of this apparatus and [AF OSCILLATOR 50 ~ 2999 Hz] digital switch on the front panel are connected in parallel. Therefore, if the digital switch is operated with the remote control terminal connected, setting to the correct frequency can not be done.

NOTE: For the remote controller, use an IC of open-collector so that there may be no problem even if the output is grounded.

3.6 Stopping Procedure

(1) Disconnect this apparatus from the equipment under measurement (such as transceiver).

(2) Turn [LINE] (power) switch to [OFF].

(3) Disconnect the power cord from the AC power source.

SECTION 4

OPERATING INSTRUCTIONS

4.1 Introduction

This section describes procedures for the measurement and adjustment of the characteristics of transmitter and receiver portions of the transceiver. For these descriptions, it is assumed that the preparation in 3.4.3 has been completed and this apparatus is applied with power.

4.2 Connection of Microphone Cord

Connect the microphone connector of the transceiver to [TO TRANSCEIVER] of this apparatus using the attached cord. Connections of conductors of the attached cord are as follows.

Red : Modulation signal (pin No.3)

Black : Press-to-talk (pin No.2)

Shield: Ground (pin No.1)

The connection of the microphone connector of this apparatus is as shown in Fig.4-1.

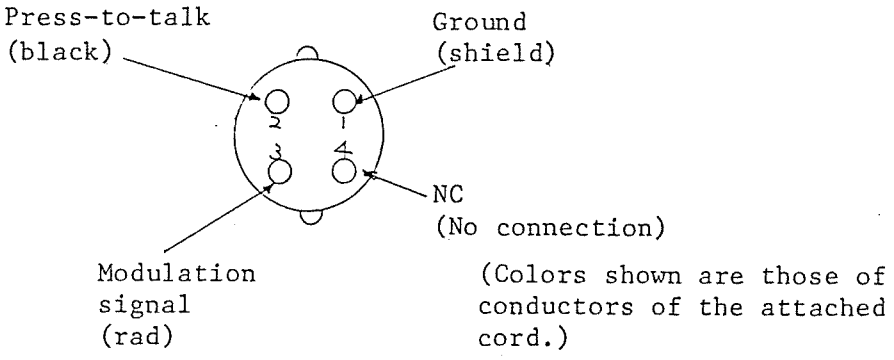

Fig.4-1 Connection of the microphone connector

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4.3 Operating Procedures

4.3.1 Connection for transmitter test

Connect the transceiver under measurement to this apparatus as shown in Fig.4-2.

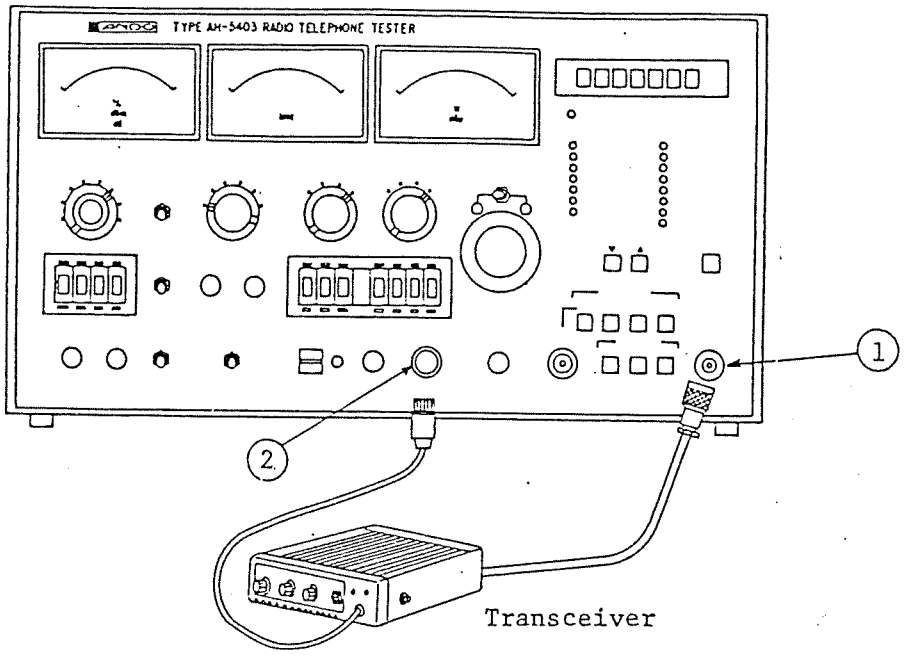

Fig.4-2 Connection of the transceiver
(for transmitter test)

Connect the antenna connector of the transceiver to the type N connector marked with [FR INPUT/OUTPUT 50Ω MAX. 25W] of ①.

Connect the microphone input connector of the transceiver to the connector marked with [TO TRANSCEIVER] of ②.

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4.3.2 RF power and frequency measurement

[At this measurement item, the average power supplied to the antenna of a transceiver or the like and the RF measurement are measured.]

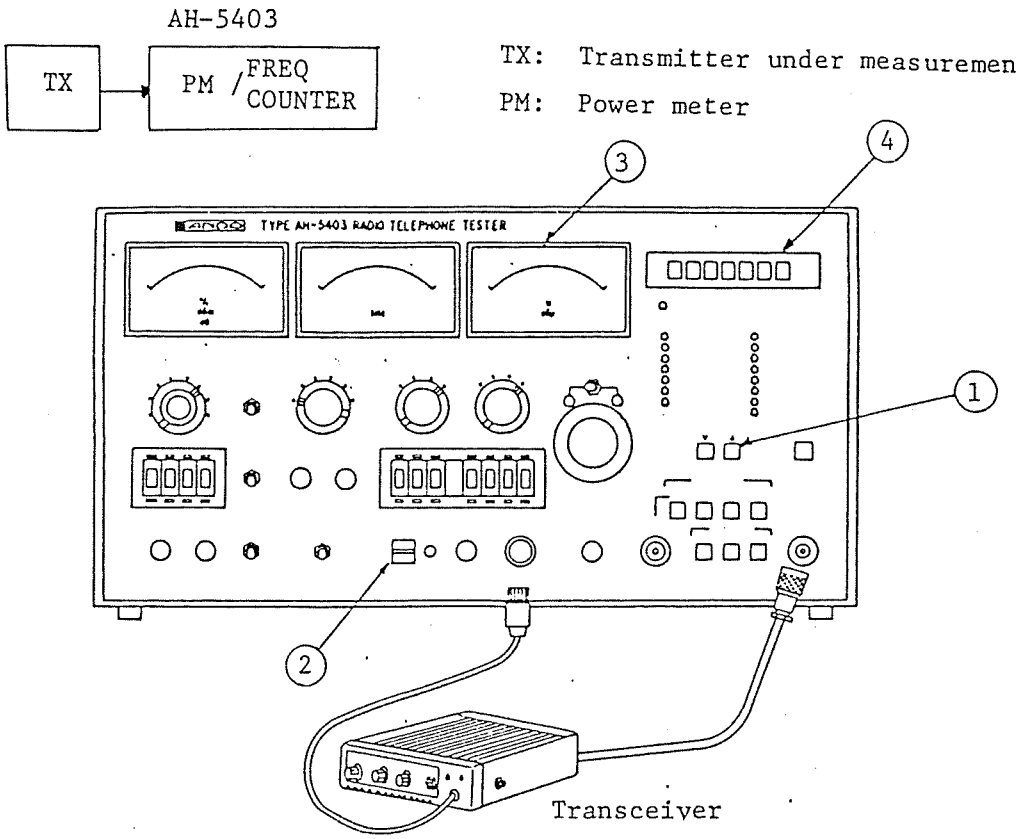

Fig.4-3 RF power and frequency measurement

Depress the measurement item selector switch marked with ▼ or ▲ of ① to set the measurement item to any item of [TRANSMITTER TEST].

When the switch of ② which corresponds to the press-to-talk switch of the transceiver is turned to [TX], the transmitted power can be read on the power meter of ③ and the transmit frequency on the counter of ④.

REMARKS

* The power meter has ranges of 1.5, 7.5, 15 and 30W full scale,

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but for the purpose of meter protection, the initial setting should be made to [30]W.

* The power meter is of termination type having a measuring frequency range from 25 to 520 MHz. Measurement can be done independently of the frequency setting switch, etc.

* When adjusting the transmitted power of a transceiver or the like, adjustments should be made slowly because a time lag is produced by the limited follow-up speed of the power meter.

4.3.3 How to use [OUTPUT (REAR)]

At the rear of this apparatus, [RF OUTPUT] connector is provided for measuring the spurious component of the transmitter output signal of a transceiver, etc. How to use this connector is described below.

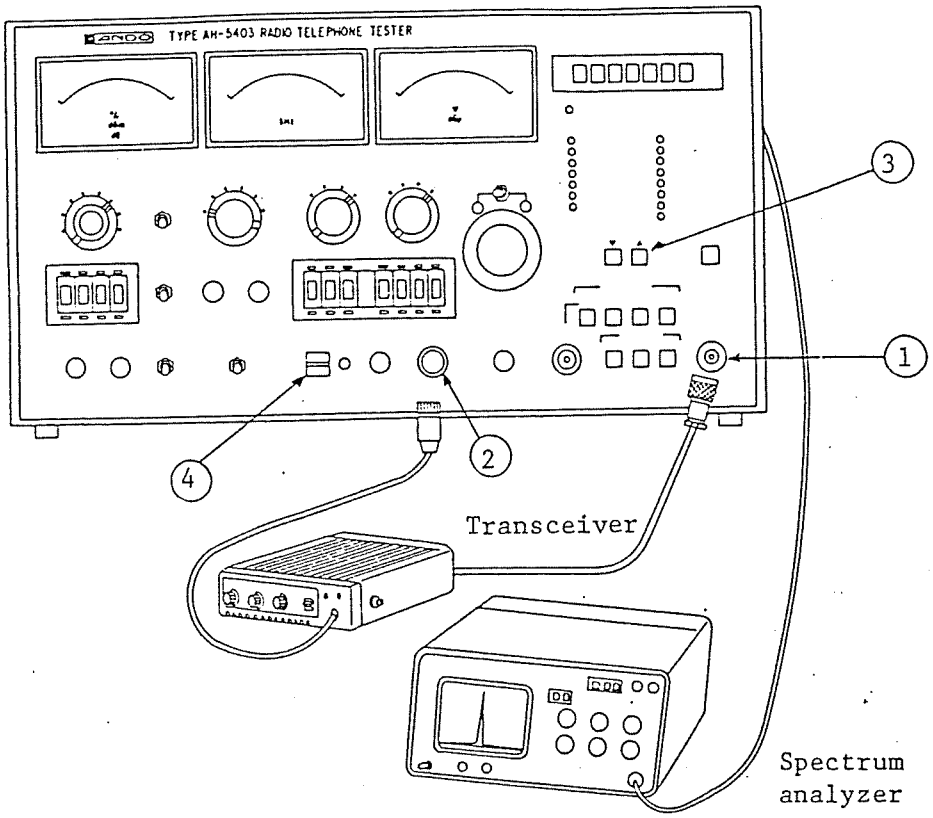
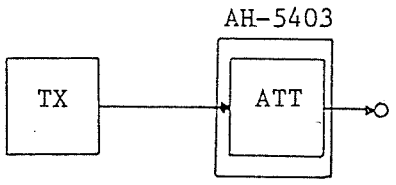


Fig.4-4 How to use [OUTPUT (REAR)]



TX: Transmitter under measurement

ATT: 40 dB attenuator

Connect the antenna connector of the reansceiver to [RF INPUT/OUTPUT 50Ω] connector of (1).

Connect the microphone connector of the transceiver to [TO TRANSCEIVER] connector of (2).

Depress [▼] or [▲] button of (3) to set the measurement item to [OUTPUT (REAR)] of [TRANSMITTER TEST].

Turn the switch of (4) to [TX (LOCK)] and an output which is 40 dB down (1/10,000) from the output level of the transceiver will be available at [RF OUTPUT] at the rear.

Using a spectrum analyzer connected to [RF OUTPUT] at the rear, the spurious characteristic, etc. can be measured.

4.3.4 RF transmit frequency difference (ΔF) measurement

- RF FREQUENCY (ΔF)

[At this measurement item, the difference (deviation) between the transmit frequency of a transceiver or the like and the reference frequency is measured.]

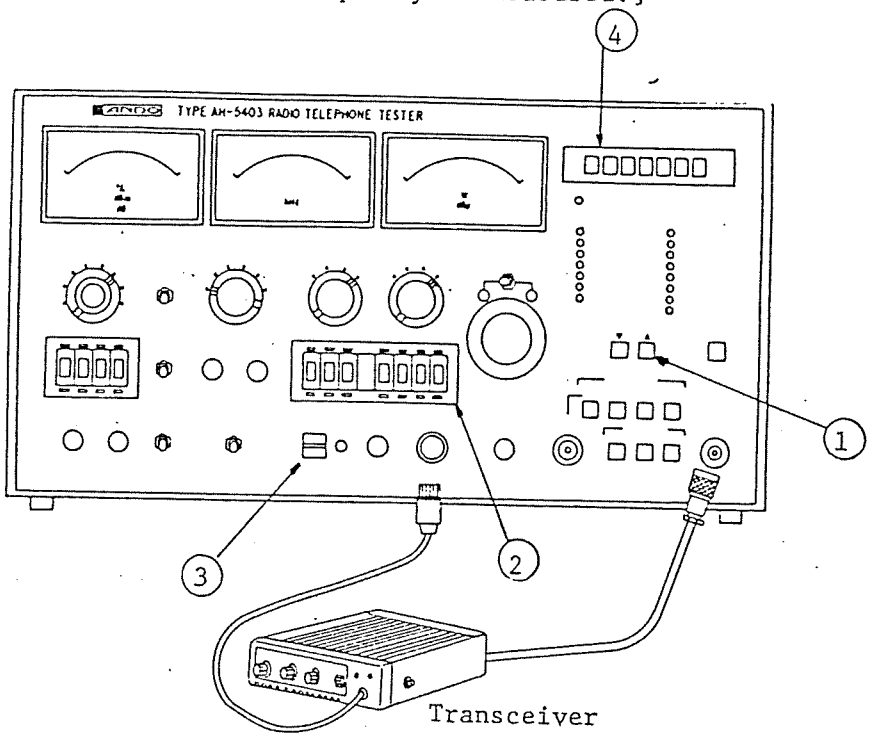
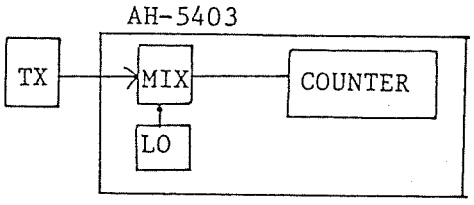


Fig.4-5 Transmit frequency difference measurement



TX: Transmitter under measurement
MIX: Mixer
LO: Local oscillator (synthesizer)

Depress the measurement item selector switch marked with ▼ or ▲ of ① to set the measurement item to [RF FREQUENCY (ΔF)].

Set [RF FREQUENCY 25～520 NHz] of ② to the transmit frequency of the transceiver.

Turn the switch of ③ which corresponds to the press-to-talk switch of the transceiver to [TX LOCK].

On the frequency counter of (4), the difference between the frequency set by means of (2) and the transmit frequency of the transceiver is displayed. Adjust the transmit frequency so that this frequency difference may be 0.

NOTE:	The difference frequency of the input frequency with reference to the RF signal oscillator frequency as the reference frequency is displayed, and that frequency ΔF is less than ± 900 kHz. If the input frequency is not clearly known, or ΔF is more than ± 900 kHz, set the measurement item to any position other than [RF FREQUENCY (ΔF)] and measure the input frequency.

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4.3.5 Modulation input sensitivity measurement

o AUDIO SENSITIVITY

[At this measurement item. the modulation input level required for the standard modulation of a transceiver or the like is measured.]

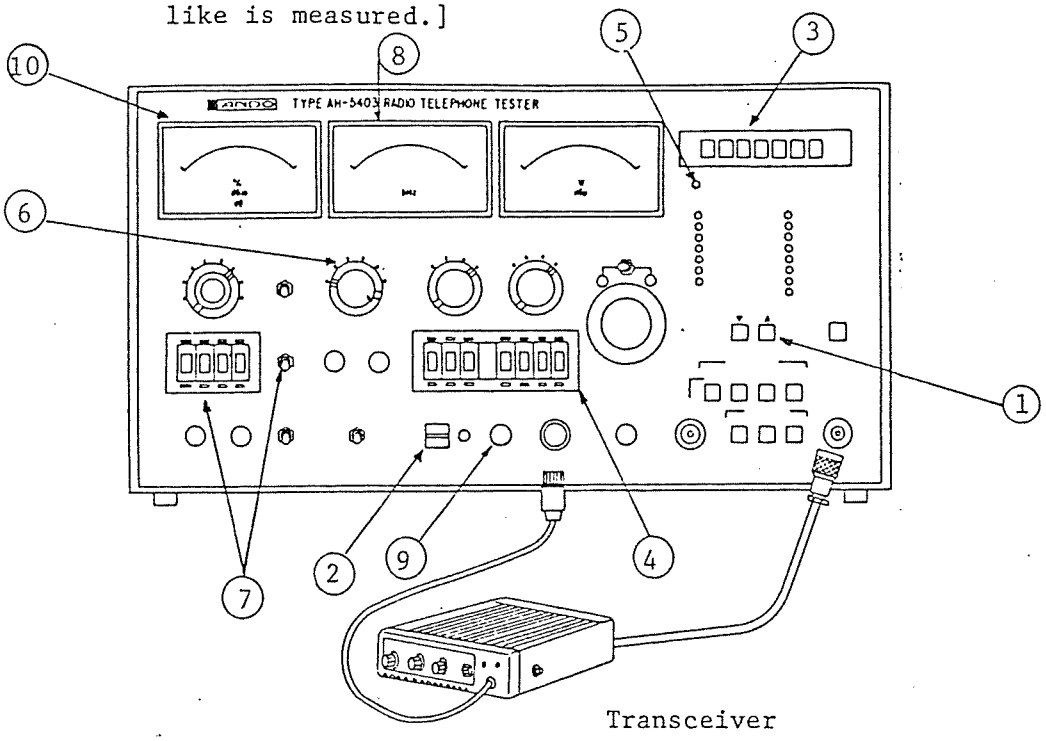
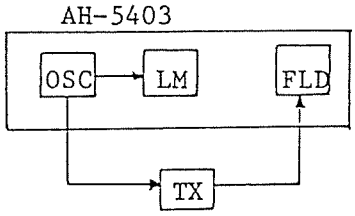


Fig.4-6 Modulation input sensitivity measurement



TX: Transmitter under measurement
OSC: AF oscillator
LM: Level meter
FLD: FM linear detector

Depress the measurement item selector switch marked with ▼ or ▲ of ① to set the measurement item to [AUDIO SENSITIVITY].

Turn the switch of ② which corresponds to the press-to-talk switch of the transceiver to [TX].

On the frequency counter of ③, the transmit frequency of the transceiver is displayed.

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Set the frequency setting digital switch of ④ to the transmit frequency of the transceiver (as displayed on the frequency counter).

A red LED of [FM DEMO OPERATION] of ⑤ will light.

For 1 kHz internal modulation, turn [MOD SELECT] switch of ⑥ to [1 kHz] or [1 kHz + INT]. For applying modulation by [AF OSCILLATOR] of ⑦, set [MOD SELECT] switch to [INT]. For external signal modulation, turn [MOD SELECT] switch of ⑥ to [EXT] or [EXT + INT] and connect an external AF signal to [EXT AF INPUT] connector at the rear.

By adjusting the modulation level knob marked with [LEVEL] of ⑨ while watching the deviation meter of ⑧, the standard modulation with 1 kHz test tone can be applied to the transceiver.

The modulation input level at that time can be read on the level metar of ⑩.

In the case of modulation by an external signal, measuremtnts can be made similarly to the internal modulation.

[APPLIED MEASUREMENT]

[Check of IDC circuits (instantaneous deviation control circuits)]

The operating condition of the IDC circuit can be checked by adjusting the modulation level knob marked with [LEVEL] of ⑨ and reading the modulation input level vs. deviation relation of the transceiver.

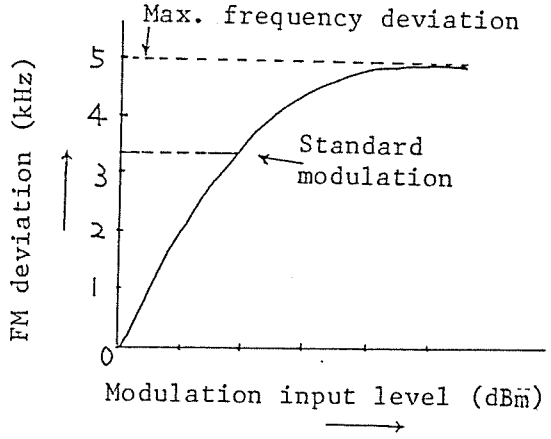

Fig.4-7 Example of IDC characteristics

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NOTE: In the case of a transceiver with a tone signal, the sum of deviations with the tone signal and the 1 kHz signal is indicated. For the standard modulation, proceed as follows, since this apparatus employs the peak detection-indication system. First, set the deviation with the tone signal to 0.5 kHz and then apply the modulation by a 1 kHz signal, and the level at which the sum deviation is 3.5 kHz gives the modulation input sensitivity.

NOTE: Even if [MOD SELECT] switch is set at [1 kHz + INT] or [EXT + INT], the transceiver is modulated by the 1 kHz or EXT signal only. The INT signal is not superposed.

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4.3.6 Deviation measuremnt

- AF LEVEL SET

[At this measurement item, the deviation during transmission of the transceiver is measured.]

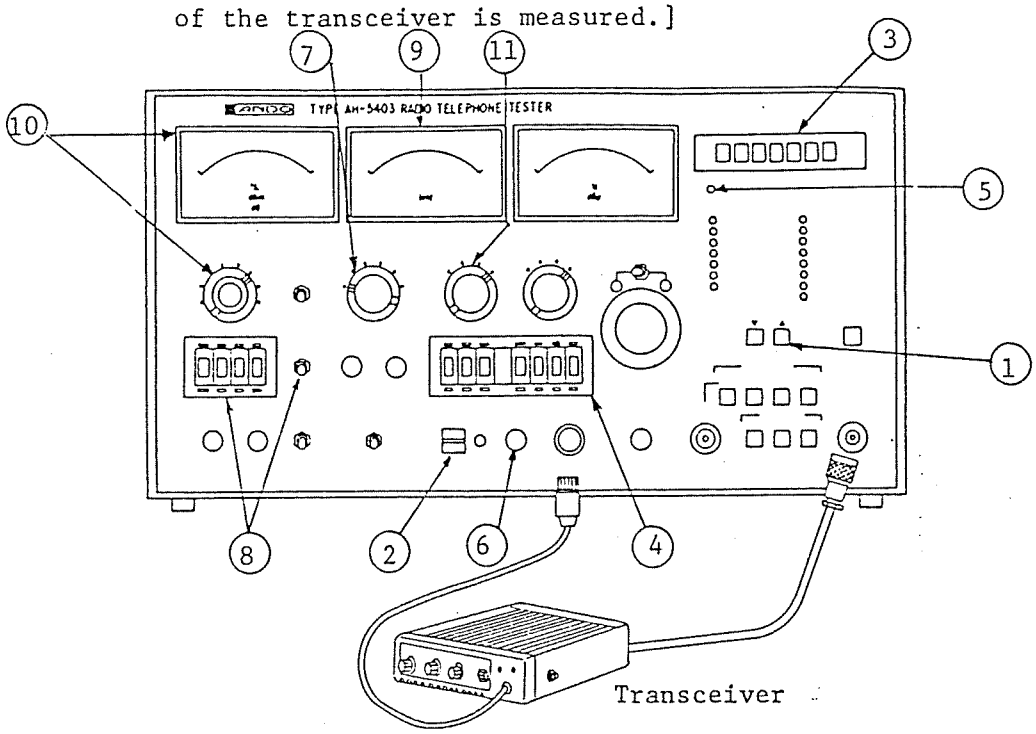
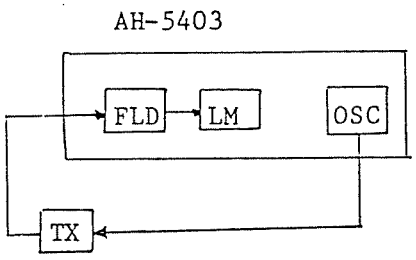


Fig.4-8 Deviation measurement



TX: Transmitter under measurement
OSC: AF oscillator
FLD: FM linear detector
LM: Level meter

Depress ▲ or ▼ button of (1) to set the measurement item to [AF LEVEL SET].

Turn the switch of (2) to [TX (LOCK)].

The transmit frequency of the transceiver is displayed on the frequency counter of (3).

Set [RF FREQUENCY] digital switch of (4) to the transmit frequency (as displayed on the counter) of the transceiver.

A red LED of [FM DEMO OPERATION] of ⑤ lights and modulation with the AF signal can be applied to the transceiver using [LEVEL] knob of ⑥.

NOTE: Set [MOD SELECT] switch of ⑦ to [1 kHz] or [1 kHz + INT]. If [AF OSCILLATOR] of ⑧ is to be used, set [MOD SELECT] switch of ⑦ to [INT].

The FM deviation can be read on the deviation meter of ⑨.

At the same time, the signal demodulated is supplied to the AF level meter of ⑩.

For external modulation, set [MOD SELECT] switch of ⑦ to [EXT], and modulation can be applied to the transceiver from [EXT INPUT] connector at the rear.

NOTE: Even if [MOD SELECT] siwtch is set at [1 kHz + INT] or [EXT + INT], the transceiver is modulated by the 1 kHz or EXT signal only. The INT signal is not superposed.

[On the deviation measurement of the tone signal:]

The deviation measurement of the tone signal of the transceiver can be made as follows. The connection is shown in Fig.4-6.

Turn [MOD SELECT] switch of ⑦ to [OFF], or turn [LEVEL] adjustment knob of ⑥ fully counterclockwise.

Set [DIVIATION kHz] range of ⑪ to [1] (kHz).

NOTE: The [1] (kHz) range of [DEVIATION kHz] range of ⑪ is the range dedicated for the tone signal, and at this range, a low-pass filter LPF is inserted to eliminate signals higher than 500 Hz. Thus, deviations of AF signals higher than 500 Hz can not be measured.

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4.3.7 Modulation distortion factor or S/N measurement of the transmitter

- AF LEVEL SET
- DISTORTION
- S/N

[At this measurement item, the modulation distortion factor or signal to noise ratio during transmission of the transceiver is measured.]

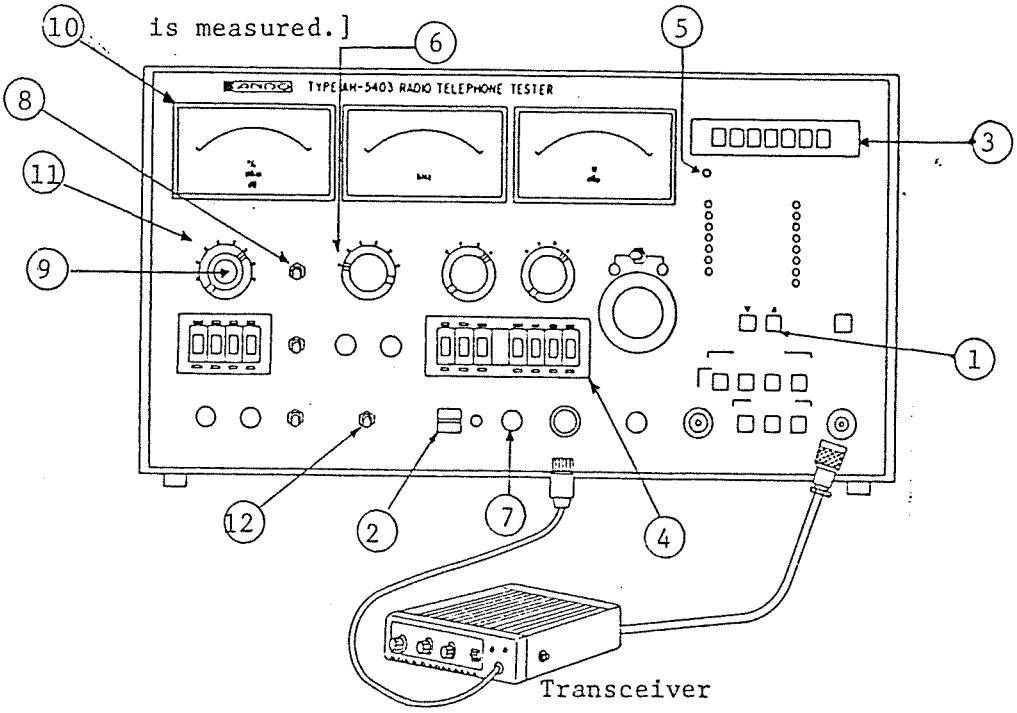
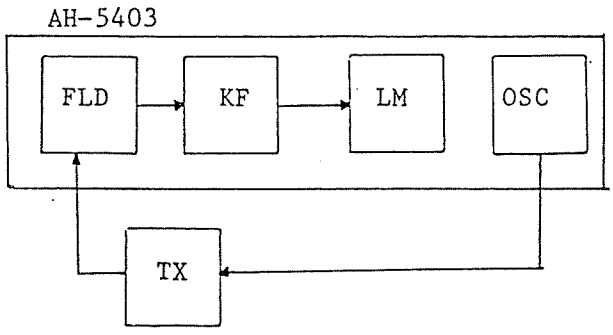


Fig.4-9 Distortion factor or S/N measurement



TX: Transmitter under measurement
FLD: FM linear detector
KF: Fundamental eliminating circuit (distortion factor meter)
LM: Level meter
OSC: AF oscillator

Depress ▲ or ▼ button of (1) to set the measurement item to [AF LEVEL SET].

Turn the switch of (2) to [TX (LOCK)].

Set [RF FREQUENCY] digital switch of (4) to the transmit frequency (as displayed on the frequency counter) of the transceiver.

A red LED of [FM DEMO OPERATION] of (5) lights. The standard modulation with a 1 kHz test tone is applied to the transceiver by setting [MOD SELECT] switch to [1 kHz] or [1 kHz + INT] and using [LEVEL] knob of (7).

Adjust [100% SET] input attenuator of (8) and [LEVEL] knob of (9) so that the pointer of the level meter which indicates the signal demodulated in the FM linear detector portion may deflect up to 100% full scale.

Set the measurement item of (1) to [DISTORTION], and a filter circuit which eliminates 1 kHz will operate and the distortion factor can be measured using [LEVEL] switch of (11) and the meter of (10).

Then, set the measurement item of (1) to [S/N], and the modulation signal supplied to the transceiver is turned off and the signal to noise ratio can be measured on the dB scale.

NOTE: Set [AF BW] switch of (12) to the required demodulation band. In case the tone signal is applied, however, this switch should be set surely to [400 Hz 3 kHz], otherwise the tone signal may interfere with the distortion factor measurement or S/N measurement.

NOTE: Even if MOD SELECT switch is set at [1 kHz + INT] or [EXT + INT], the transceiver is modulated by the 1 kHz or EXT signal only. The INT signal is not superposed.

4.3.8 Tone signal frequency measurement

The tone signal frequency of a transceiver provided with a tone signal can also be measured accurately in a short time with use of the internal frequency counter.

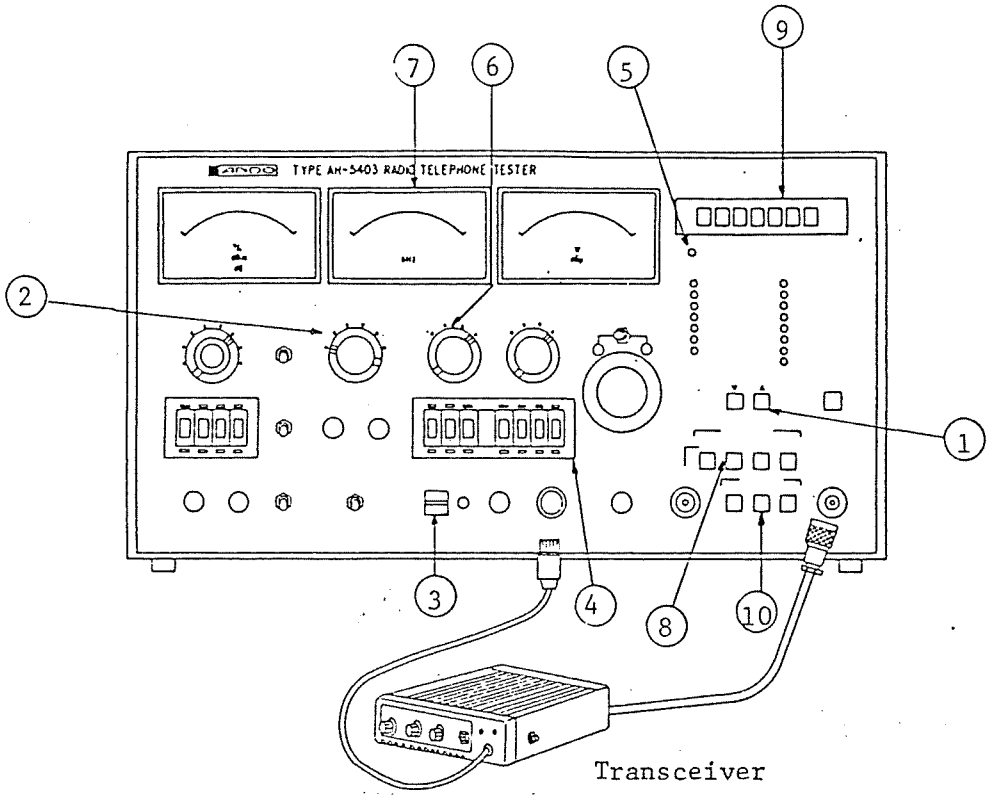


Fig.4-10 Tone signal frequency measurement

Depress [▲] or [▼] button of (1) to set the measurement item to [TX MOD FREQUENCY].

Set [MOD SELECT] switch of (2) to [OFF].

Set the switch of (3) to [TX (LOCK)].

Set [RF FREQUENCY (MHz)] digital switch of (4) to the transmit frequency of the transceiver.

[FM DEMO OPERATION] lamp of (5) lights. By setting [DEVIATION kHz] range switch of (6) to [1 kHz], the deviation with the tone signal of the transmitter can be read on the diviation meter of (7).

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Set [INPUT SELECT] switch of (8) to [10~260 Hz].

At [FREQUENCY] of (9), the tone signal frequency is displayed.

Set [RESOLUTION] switch of (10) to [10 mHz], and the measurement can be made in 0.01 Hz steps and in a short time of 0.1 second.

NONE: Not only the tone signal frequency, but also the AF modulation signal frequency up to 3 kHz can be measued. For frequencies higher than 260 Hz, set [INPUT SELECT] of (8) to [10 Hz 50 MHz].

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4.3.9 Connection for receiver test

Connect the transceiver under measurement to this apparatus as shown in Fig.4-11.

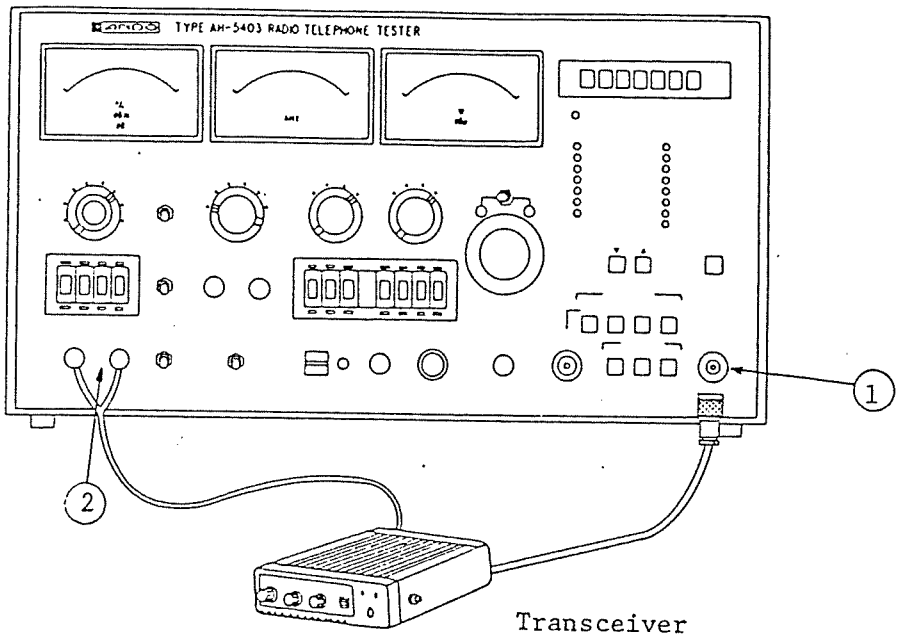


Fig.4-11 Connection of the transceiver (for receiver test)

Connect the antenna connector of the transceiver to the type N connector marked with [RF INPUT/OUTPUT 50Ω MAX. 25W] of (1).

Connect the EXT. SPEAKER terminal of the transceiver to [AF LEVEL METER INPUT] of (2).

4.3.10 Demodulation AF output level measurement of the receiver

- AF INPUT LEVEL

[At this measurement item, the receiver output level of the transceiver is measured.]

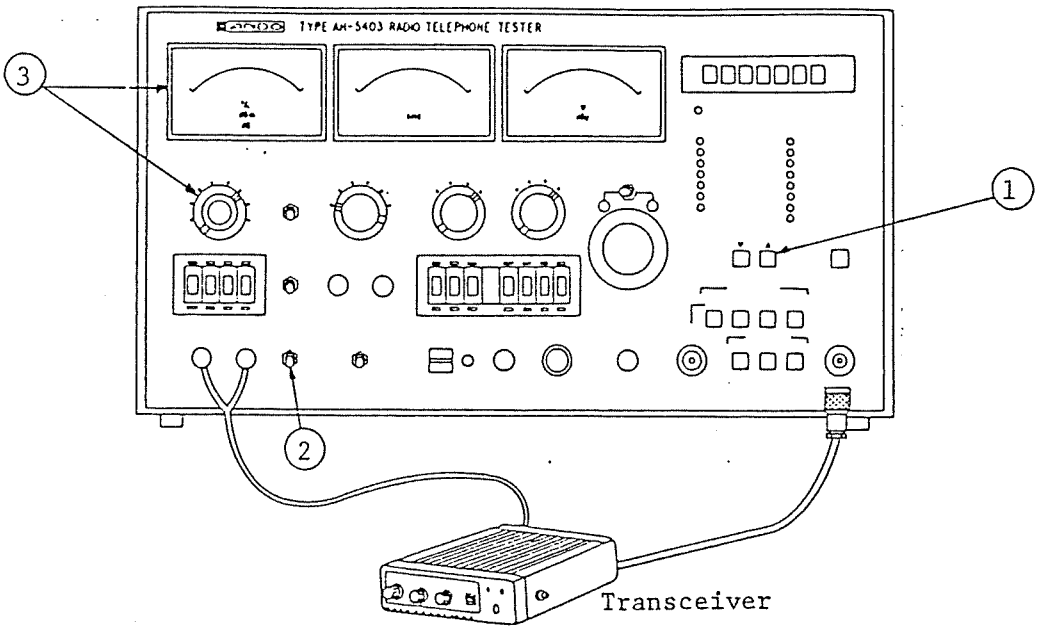
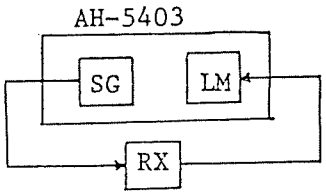


Fig.4-12 Demodulation output level measurement



RX: Receiver under measurement
SG: Signal generator
LM: Level meter

Set the RF signal generator in 3.5.5 of Paragraph 3.5 Operation to the receive frequency of the transceiver and apply standard modulation.

Depress ▲ or ▼ button of (1) to set the measurement item to [AF INPUT LEVEL].

Set the input impedance of [AF LEVEL METER] of (2) to [600Ω].

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Using [LEVEL] range switch of (3) and an AF level meter the output level can be read in dBm (600Ω).

NOTE:	For use at 4Ω, 8Ω, or 16Ω, set the impedance select switch of (2) to [600Ω] or [100 kΩ] and terminate [INPUT] terminal with the required resistance.

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4.3.11 Demodulation distortion factor or S/N measurement of the receiver

- AF LEVEL SET
- DISTORTION
- S/N

[At this measurement item, the reception overall distortion factor or signal to noise ratio of the transceiver is measured.]

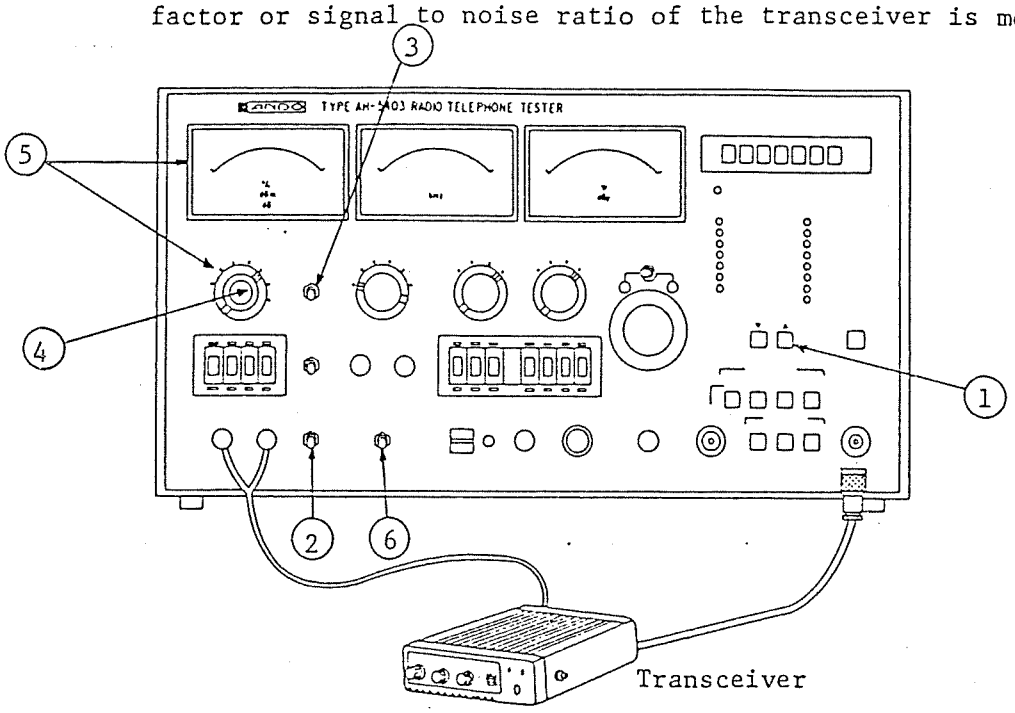
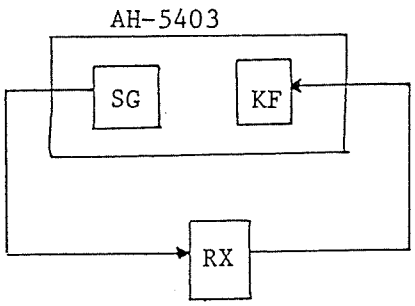


Fig.4-13 Demodulation distortion factor or S/N measurement



RX: Receiver under measurement
SG: Signal generator
KF: Distortion factor meter

Set the RF signal generator in 3.5.5 of Paragraph 3.5 Operation to the receive frequency of the transceiver and apply the standard modulation.

Depress [▲] or [▼] button of (1) to set the measurement item to [AF LEVEL SET].

Set the input impedance of [AF LEVEL METER] of (2) to [600Ω] or [100 kΩ].

Adjust [100% SET] input attenuator of (3) and [LEVEL] knob of (4) so that the pointer of the level meter which indicates the receiver output level of the transceiver may deflect up to 100% full scale.

NOTE:	The receiver output level of the transceiver should be adjusted by means of the volume control of the transceiver to the speciried value as instructed in 4.3.10 for the AF output level. (The voltage vs. power conversion graph for the teceiver output level is shown in 5.5.2.)

When the measurement item is set by means of (1) to [DISTORTION], a filter for eliminating 1 kHz operates and the reception overall distortion factor can be measured with [LEVEL] switch of (5) and the meter in [dB] or [%].

When the measurement item is set by means of (1) to [S/N] the modulation signal of the RF signal generator is shut off, the signal to the transceiver being now an unmodulated signal (CW) and the signal to noise ratio can be measured on the dB scale.

NOTE:	Set [AF BW] switch of (6) to [400 Hz 3 kHz] (the frequency range of the AF level meter is form 400 Hz up to 10 kHz), otherwise the S/N characteristic, etc. may be degraded by the unwanted component of low frequencies.

4.3.12 20 dB NQS measurement

- N SET ┐
  20 dB NQS
- MEASURE ┘

[At this measurement item, the 20 dB NQS (20 dB noise quieting sensitivity), one of receiver sensitivities of the transceiver, is measured.]

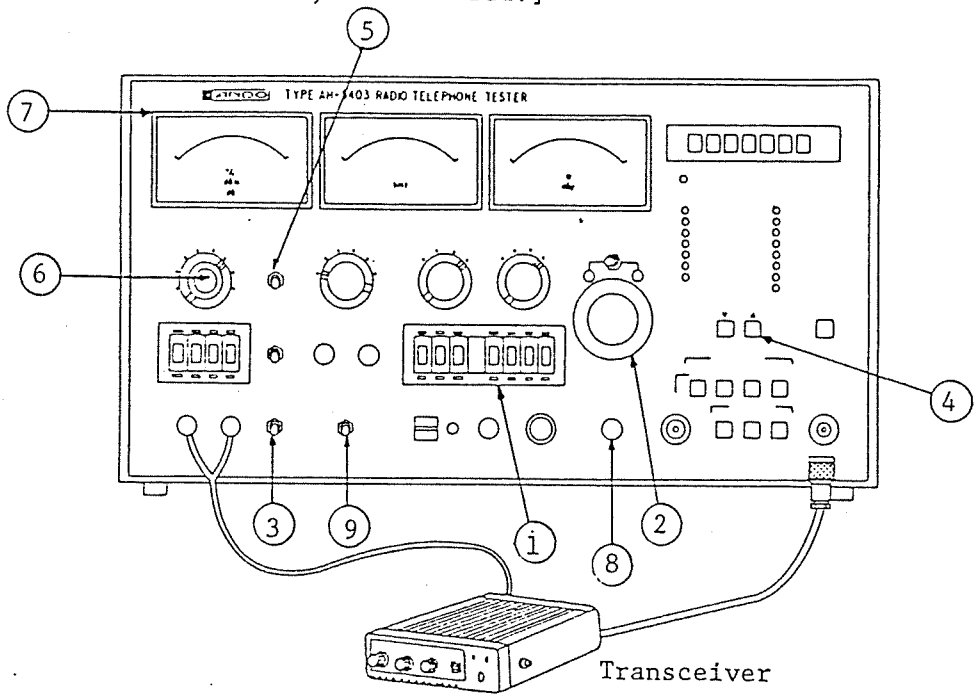
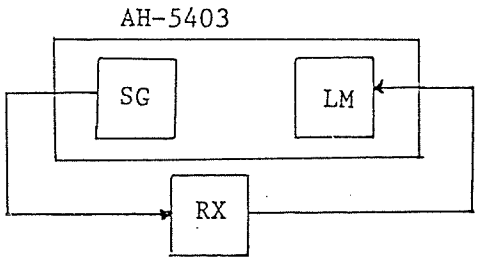


Fig.4-14 20 dB NQS measurement



RX: Receiver under measurement
SG: Signal generator
LM: Level meter

Set [RF FREQUENCY] digital switch of (1) to the receive frequency of the transceiver.

Set [OUTPUT LEVEL] attenuator of (2) to 50 dBμ or lower.

Set the input impednace of [AF LEVEL METER] of (3) to [600Ω] or [100 kΩ].

When the measurement item is set by means of (4) to [N SET], the RF signal generator output is automatically shut off and the noise level from the receiver output of the transceiver appears.

Adjust [100% SET] attenuator (0 dB/+10 dB/+20 dB) of (5) and [LEVEL] knob of (6) so that the pointer of the level meter of (7) may deflect up to full scale.

Then, set the measurement item by means of (4) to [MEASURE]. Automatically, the output of the RF signal generator is applied to the transceiver and the deflection of the level meter of (7) is reduced. Adjust [OUTPUT LEVEL] attenuator of (2) and the fine adjustment knob of (8) so that the set noise is reduced by 20 dB. The RF output level at that time gives the 20 dB NQ sensitivity.

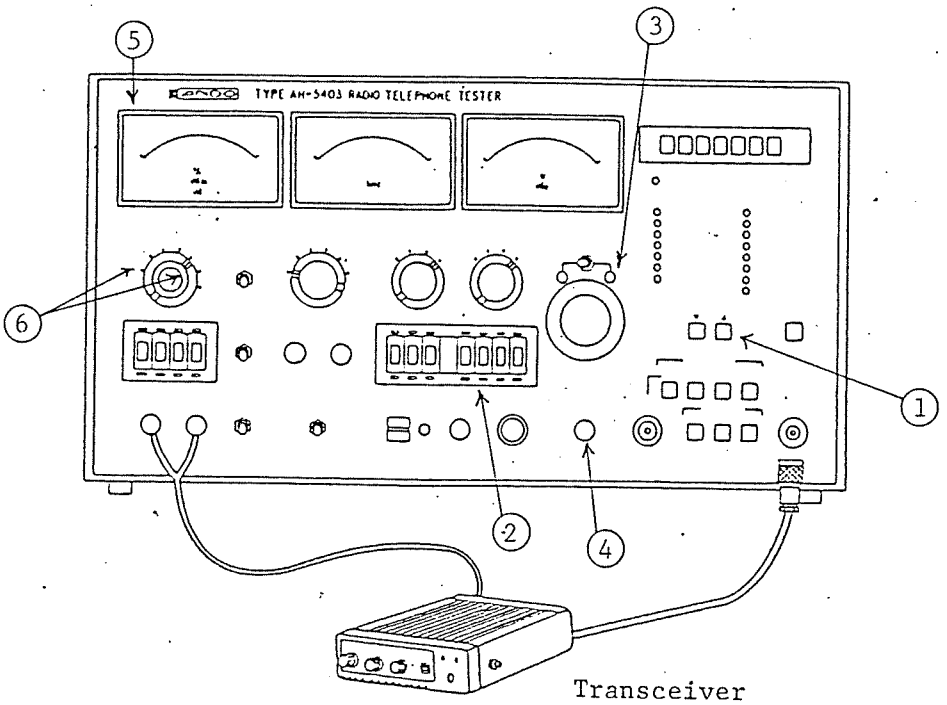
NOTE: In this measurement, the squelch of the transceiver should be kept open.

NOTE: Set [AF BW] switch of (9) to [30 Hz 3 kHz] (the frequency range of the AF level meter is from 30 Hz up to 10 kHz).

4.3.13 Receiving band width measurement

- N. SET ——— 20 dB NQS
- MEASURE ———

[Method of band width measurement by receiving the carrier. the carrier which is 6 dB higher than the minimum sensitivity (20 dB NQ sensitivity) of the wanted frequency of the transceiver]



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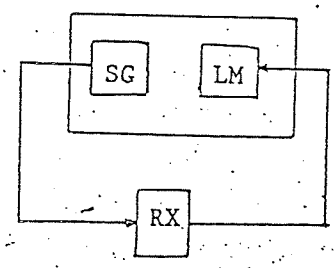

RX: Receiver under measurement
SG: Signal generator
LM: Level meter

Depress [▲] or [▼] button of (1) to set the measurement item to [SET] of [20 dB NQS].

Set [RF FREQUENCY] digital switch to the receiver frequency of the transceiver. Adjust [OUTPUT LEVEL dBμ] of (3) and [+1 - 10 dBμ] of (4) so that the output level of the RF signal generator may be 6 dB higher than the 20 dB NQ sensitivity

measured in 4.3.12.

Adjust the range knob of (6) so that the level meter of (5) may deflect to full scale.

Then, set the measurement item of (1) to [MEASURE] of [20 dB NQS].

Adjust [RF FREQUENCY] digital switch of (2) so that the noise level may be suppressed 20 dB.

Measure the frequency at that time to obtain the band width.

NOTE: In this measurement, the frequency should be varied in increasing and decreasing directions.

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4.3.14 Receiver squelch sensitivity Measurement

- AF INPUT LEVEL

The method of receiver squelch sensitivity measurement is as follows. (The squelch sensitivity is expressed in terms of the minimum input signal level at which the squelch circuit is operated with the input signal and causes the receiver to provide an output at the output terminal after the receiver noise with no input signal is quieted by means of the squelch control.)

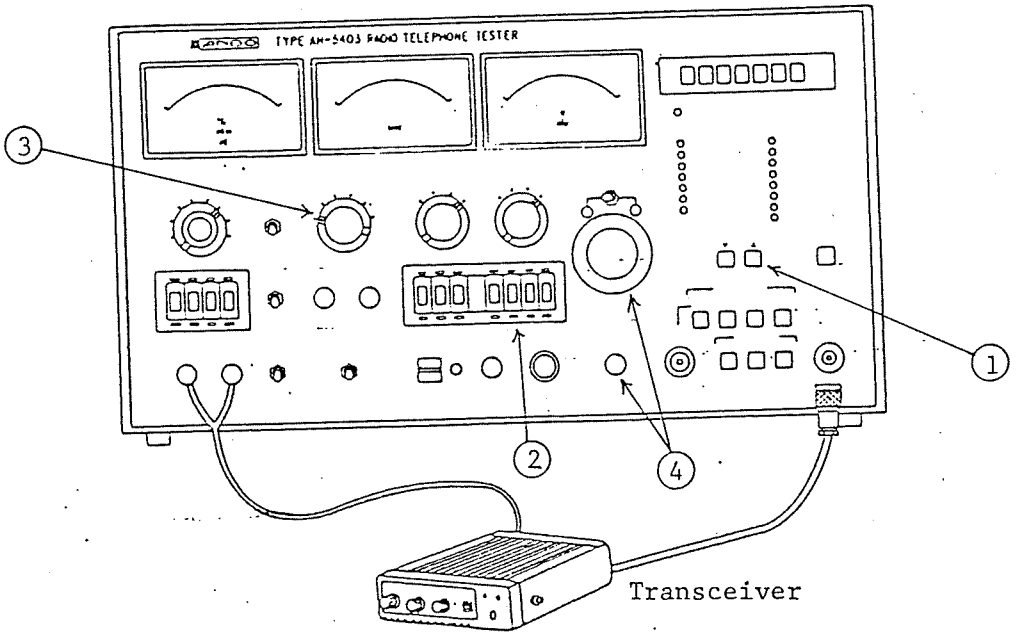

Fig.4-16 Squelch sensitivity measurement

Depress [▲] or [▼] switch of (1) to set the measurement item to [AF INPUT LEVEL].

Set the digital switch of (2) to the receive frequency.

Set [MOD SELECT] switch to [1 kHz] and apply the standard modulation.

Turn [OUTPUT LEVEL dBμ] and [+ 1 ~- 10 dBμ] knobs of (4) fully counterclockwise to turn off the output of the RF SG. The noise from the receiver appears. Adjust the squelck control of the receiver to a limit position where the noise is quieted.

Adjust [OUTPUT LEVEL dBμ] and [+ 1 - 10 dBμ] of (4) and obtain the minimum RF input signal level at which the squelch

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circuit is operated with the input signal and causes the receiver to provide an output.

Then, turn the squelch control of the receiver to the position of maximum squelch.

Adjust [OUTPUT LEVEL dBμ] and [+ 1∼10 dBμ] of (4) and obtain the minimum RF input signal level at which the squelch circuit is operated and causes the receiver to provide an output.

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4.3.15 Receiver squelch control range measurement

- N SET ——┐ 20 dB NQS
- MEASURE——┘

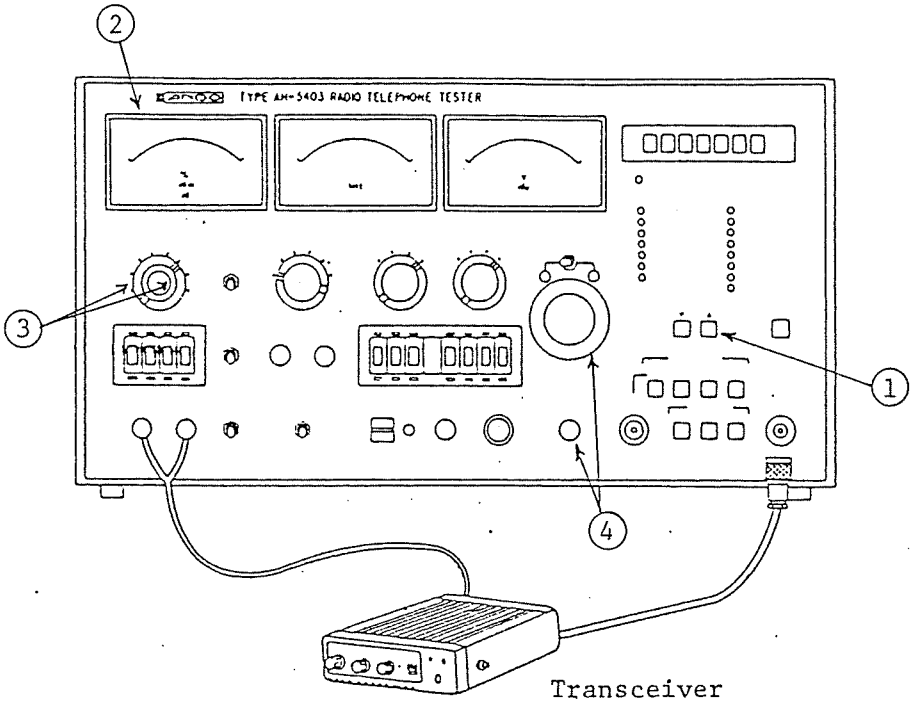

Fig.4-17 Squelch control range measurement

Depress [▲] or [▼] switch of (1) to set the measurement item to [N SET] of [20 dB NQS].

Adjust the range switch and knob of (3) so that the level meter of (2) may deflect to full scale.

Turn the squelch setting knob of the transceiver clockwise until squelch is applied (the level meter of (2) ceases to deflect).

Turn [OUTPUT LEVEL dBμ] and [+ 1 ∿ 10 dBμ] knobs of (4) fully counterclockwise.

Set the measurement item to [MEASURE] of [20 dB NQS].

Gradually increase the output level of (4) and measure the noise quieted at the minimum level at which the squelch opens on the level meter of (2).

Then, turn the squelch setting knob of the transceiver fully clockwise, and gradually raise the output level of the

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RF signal generator and measure the noise quieted at the minimum level at which the squelch opens on the level meter of (2).

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4.3.16 SINAD sensitivity measurement

- AF LEVEL SET ┐ SINAD
- MEASURE ┘

[At this measurement item, the SINAD sensitivity, one of the receiver sensitivities of the transceiver, is measured.]

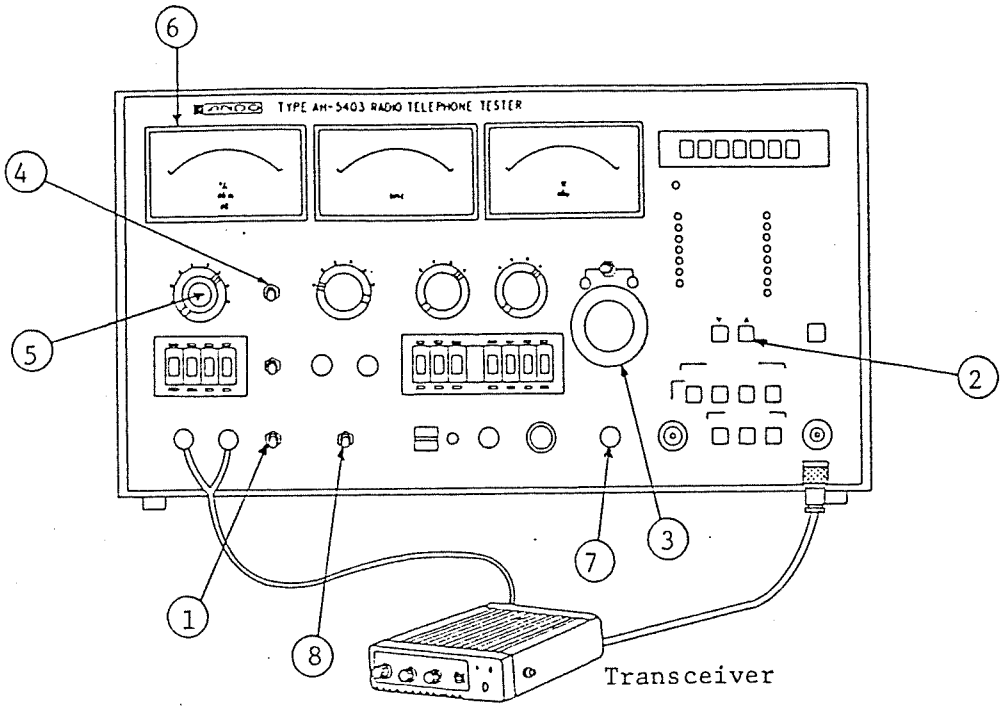
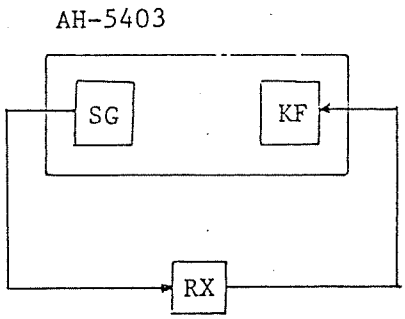


Fig.4-18 SINAD sensitivity measurement



RX: Receiver under measurement
SG: Signal generator
KF: Distortion factor meter

Set the RF signal generator in 3.5.5 of Paragraph 3.5 Operation to the receive frequency of the transceiver and apply standard modulation.

Set the input impedance of [AF LEVEL METER] of (1) to [600Ω] or [100 kΩ].

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Set the measurement item by means of (2) to [AF LEVEL SET] of [SINAD], and set [OUTPUT LEVEL] attenuator of (3) to a proper level.

Adjust [AF LEVEL SET] attenuator (0 dB/+10 dB/+20 dB) of (4) and [LEVEL] knob of (5) so that the pointer of the level meter of (6) may deflect up to full scale on a proper range.

Then, set the measurement item to [MEASURE], and the fundamental component of the 1 kHz test tone is eliminated and the pointer of the level meter of (6) drops according to the distortion factor.

Adjust [OUTPUT LEVEL] attenuator of (3) and [+ 1 - 10 dBμ] knob of (7) so that the difference in indication of the AF level meter between [AF LEVEL SET] and [MEASURE] as selected by means of (2) for the measurement item may be 12 dB or 20 dB. Then, set the measurement item again to [AF LEVEL SET] and adjust [LEVEL] knob of (5) so that the AF level meter may deflect up to full scale.

Turn the measurement item again to [MEASURE], and adjust [+ 1~- 10 dBμ] knob of (7) so that the difference in indication of the AF level meter may be 12 dB or 20 dB.

NOTE: This operation should be repeated at least four temes.

The RF output level at the time when the indication defference is 12 dB or 20 dB gives the 12 dB SINAD or 20 dB SINAD sensitivity.

NOTE: Set [AF BW] switch of (8) to [30 Hz 3 kHz] (the frequency range of the AF level meter is from 30 Hz up to 10 kHz).

4.3.17 Tone squelch opening sensitivity measurement

A tone standard modulated signal is applied to the receiver, and the minimum input signal level at which the tone squelch circuit opens and causes the receiver to provide an output is measured. This measurement may be made by any of SINAD method and noise quieting method.

(1) SINAD method (6 dB SINAD)

- AF LEVEL SET ——— SINAD
- MEASURE ———

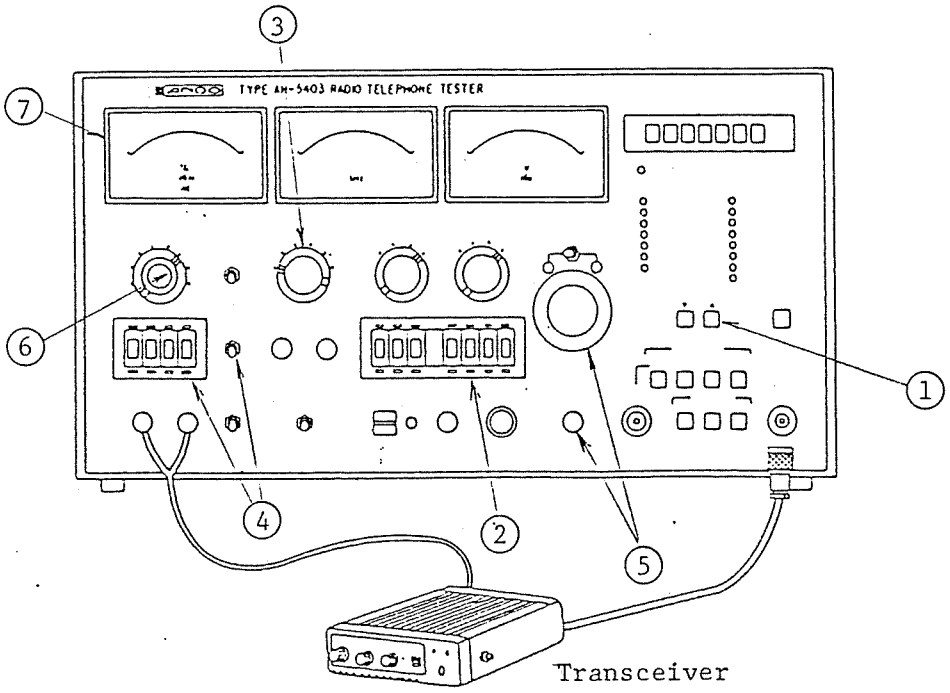

Fig.4-19 Tone squelch opening sensitivity measurement (SINAD method)

Turn off the noise squelch of the receiver.

Depress [▼] or [▲] of (1) to set the measurement item to [AF LEVEL SET] of [SINAD].

Use [RF FREQUENCY 25 ~ 520 MHz] digital switch of (2) to set the RF signal generator to the receiver frequency.

Set [MOD SELECT] switch of (3) to [INT], and set [FREQUENCY] of (4) to the tone frequency of the receiver, and apply the modulation of the RF signal generator to the tone standard modulation (±0.5KHz deviation).

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Adjust [OUTPUT LEVEL dBμ] and [+ 1~ - 10 dBμ] of (5) to the minimum input signal level at which the squelch circuit opens and the AF level meter deflect with noise.

Then turn off the tone decoder of the receiver.

Set [MOD SELECT] of (3) to [1 kHz], and apply the modulation of the RF signal generator to the tone squelch standard modulation (±3 kHz deviation).

Adjust the level control of (6) so that the AF level meter of (7) may deflect to full scale.

Depress [▼] of (1) to set the measurement item to [MEASURE] of [SINAD].

Confirm that the indication of (7) is below 6 dB (SINAD at the receiver output is below 6 dB).

(2) Noise quieting method (10 dB NQ)

- N SET ——— 20 dB NQS
- MEASURE ———

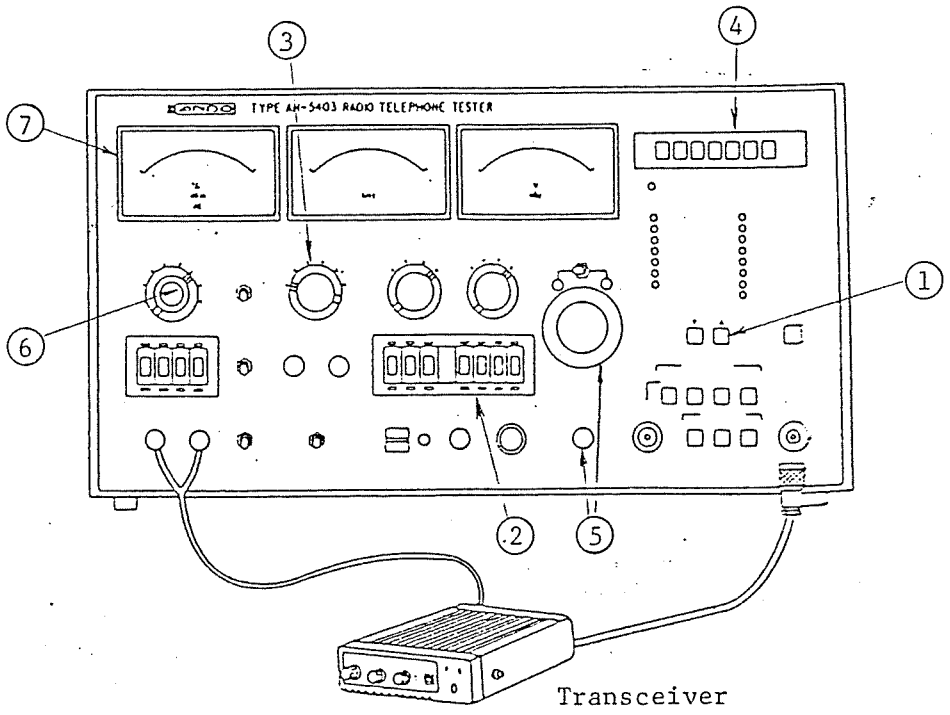

Fig.4-20 Tone squelch opening sensitivity measurement (noise quieting method)

Turn off the norse squelch of the receiver.

Depress [▲] or [▼] switch of (1) to set the measurement

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item to [MEASURE] of [20 dB NQS].

Use [RF FREQUENCY 25∼520 MHz] ditital switch of (2) to set the RF signal generator to the receive frequency.

Set [MOD SELECT] switch of (3) to [INT], and set [FREQUENCY] of (4) to the tone frequency of the receiver and apply the tone standard modulation to the RF signal generator.

Adjust [OUTPUT LEVEL dBμ] and [+ 1∼- 10 dBμ] of (5) and measure the minimum input signal level at which the squelch circuit opens.

Then turn off the tone decoder of the receiver.

Turn [MOD SELECT] of (3) to [OFF], and depress [▲] of (1) to set the measurement item to [N SET].

Adjust the level control of (6) so that the AF level meter of (7) may deflect to full scale.

Depress [▼] of (1) to set the measurement item to [MEASURE] (20 dB NQS).

Confirm that the indication of (7) is below 10 dB (noise quieted at the receiver output is below 10 dB).

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4.3.18 Receive frequency measurement and adjustment

- EXT COUNTER

[At this measurement item, the receive frequency of the transceiver is adjusted or measured.]

Connect the signal of the receiver to be measured and adjusted to [INPUT] of the frequency counter as shown in Fig.4-21.

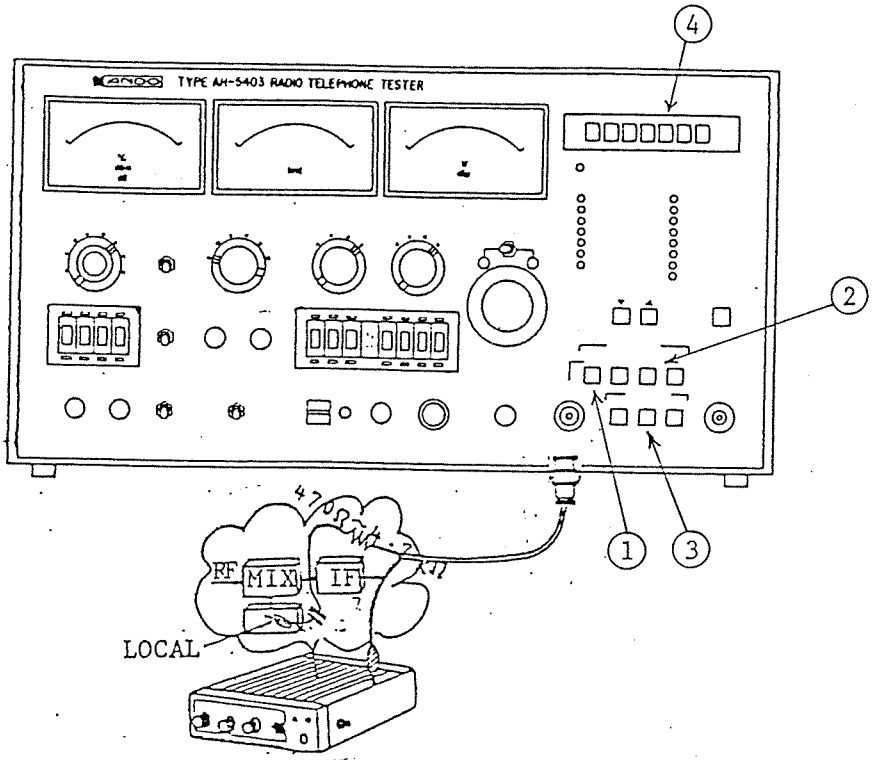

Fig.4-21 Receive frequency measurement and adjustment

Depress [EXT] switch of [COUNTER MODE] of (1).

Set [INPUT SELECT] switch of (2) to the measurement frequency range.

Set [RESOLUTION] switch of (3) to the desired resolution frequency.

On the frequency counter of (4), the signal of the signal to be measured and adjusted is displayed.

NOTE: The maximum input level of [EXT] input terminal is 2 Vrms. Take care not to apply excessive levels to cause burnout.

SECTION 5

REFERENCE DATA

5.1 Introduction

This section contains reference data such as terminology in frequent use for mobile radio equipment, radio frequency allocation table for simple service, tone signal frequency table, dBm-V and other conversion graphs.

5.2 Terminology

- SSG: Means Standard Signal Generator.
- PPM: Means Parts Per Million (10^{-6}). A unit used for expressing accuracy, stability, etc.
- FM : Means Frequency Modulation.
- AF : Means Audio Frequency.
- IF : Means Intermediate Frequency.
- RF : Means Radio Frequency.
- Renarrowing plan: For example, channel frequencies in the 400 MHz band are allocated currently at 25 kHz spacings. For overcoming the frequency shortage, a halved spacing of 12.5 kHz is contemplated in this plan.
- Deviation: Means the maximum frequency deviation in the frequency modulation scheme.
- Standard modulation: The maximum frequency deviation according to the current radio wave regulations is ± 5 kHz. The standard modulation means a modulation at 70% deviation (± 3.5 kHz).
- IDC: Means Instantaneous Deviation Control. In the FM or PM modulation, the occupied frequency band width becomes wide enough to cause the side band to interfere with adjacent channels as the modulation index is increased (modulation frequency x modulation index = deviation). In the mobile radio systems where radio channels are arranged at 25 kHz spacings, the maximum frequency deviation is limited to ± 5 kHz. The transceiver is provided with an automatic

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frequency deviation control circuit such as IDC (instantaneous deviation control) circuit. Moreover, the modulation frequency is limited to 3 kHz or lower, in order to prevent the side band distribution from widening.

- Tone signal: In the selective calling systems, the circuit is not opened if the tone signal is different even with the same channel. In Japan, tone signal frequencies are specified as 33 consecutive single frequences between 60 and 260 Hz. (Refer to Table 5-2.)
- Squelch: A function to automatically shutting off the output when the noise increases beyound a certain level. It is the same as MUTE which is used in the FM tuner.
- 20 dB NQS: In the FM receiving systems, with no RF signal, a noise only is output, and when an RF signal is input, the noise is quieted. The degree of noise quieting is determined by the intensity (level) of the RF signal and the receiver sensitivity, and is expressed in terms of an RF signal level which is required for the noise to be quieted by 20 dB (down to 1/10). The smaller this value, the better the receiver sensitivity may be.
- SINAD: Means Signal + Noise + Distortion to Noise + Distortion Ratio. The SINAD sensitivity is measured with an RF signal modulated by the standard modulation of 70% with 1 kHz and is expressed in terms of an RF signal level at which the overall noise including the distortion is suppressed by 12 dB or 20 dB. It is a receiver sensitivity like the 20 dB NQS, but since the 20 dB NQS is measured with an unmodulated signal, the SINAD sensitivity may be nearer the service condition of the receiver. A 1 kHz distortion factor measuring function becomes necessary.
- Tone standard modulation: Means the modulation with a tone signal, and the frequency deviation is ±0.5 kHz.
- Tone squelch standard modulation: Means the modulation with a standard modulation frequency (1 kHz), and the frequency deviation is ±0.5 kHz.

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5.3 Radio frequency allocation table for simple service

Table 5-1

Frequency (MHz)	
VHF band	UHF band
154.45	465.050
154.47	465.075
154.49	465.100
145.51	465.125
154.53	465.150
154.55	468.750
154.57	468.775
154.59	468.800
154.61	468.825
	468.850

5.4 Tone signal frequency table

Table 5-2

Frequency (Hz)			
Group A		Group B	
A 1	107.2	B 1	179.9
A 2	114.8	B 2	167.9
A 3	123.0	B 3	156.7
A 4	131.8	B 4	146.2
A 5	141.3	B 5	136.5
A 6	151.4	B 6	127.3
A 7	162.2	B 7	118.8
A 8	173.8	B 8	110.9
A 9	186.2	B 9	103.5
A10	203.5	B10	94.8
A11	218.1	B11	82.5
A12	233.6	B12	71.9
A13	250.3	B13	241.8
A14	67.0	B14	225.7
A15	77.0	B15	210.7
A16	88.5	B16	192.8
A17	100.0		

5.5 Various Conversion Graphs

5.5.1 dBm (600Ω) vs. voltage conversion graph

The AF level meter of this apparatus assumes 0 dBm = 0.775V in the 600Ω system. The dBm (600Ω) to voltage conversion graph is shown in Fig.5-2.

For obtaining voltage from the AF level meter indication (dBm) use Fig.5-2.

The power cap be obtained by using Fig.5-2, Fig.5-3 and the equation in 5.5.2 of paragraph 5.5.

5.5.2 For obtaining power from load impednace and voltage

In Fig.5-1, power P(W) due to voltage E(V) applied across impedance R(Ω) is given by

$$P(W) = \frac{E^2}{R}$$

The conversion graph is shown in Fig.5-3.

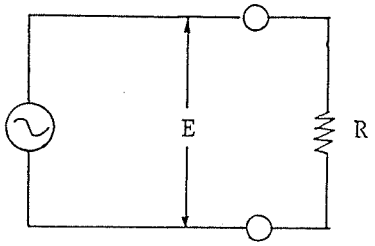

Fig.5-1

5.5.3 WATT vs. dBm conversion graph

dBm is a unit of power and refere to 1 mW = 0 dBm. The WATT vs. dBm relation is given by

$$P(W) = 10 \log \frac{P(W)}{1\ mW}\ (dBm)$$

The WATT vs. dBm conversion graph is shown in Fig.5-4.

5.5.4 dBμ vs. V conversion graph

The output level of the signal generator of this apparatus is expressed in dBμ. dBμ is a unit of volgage and refers to 0 dBμ = 1 μV.

The dBμ vs. voltage (V) conversion graph is shown in Fig.5-5. The output level of this apparatus is specified in terms of open voltage.

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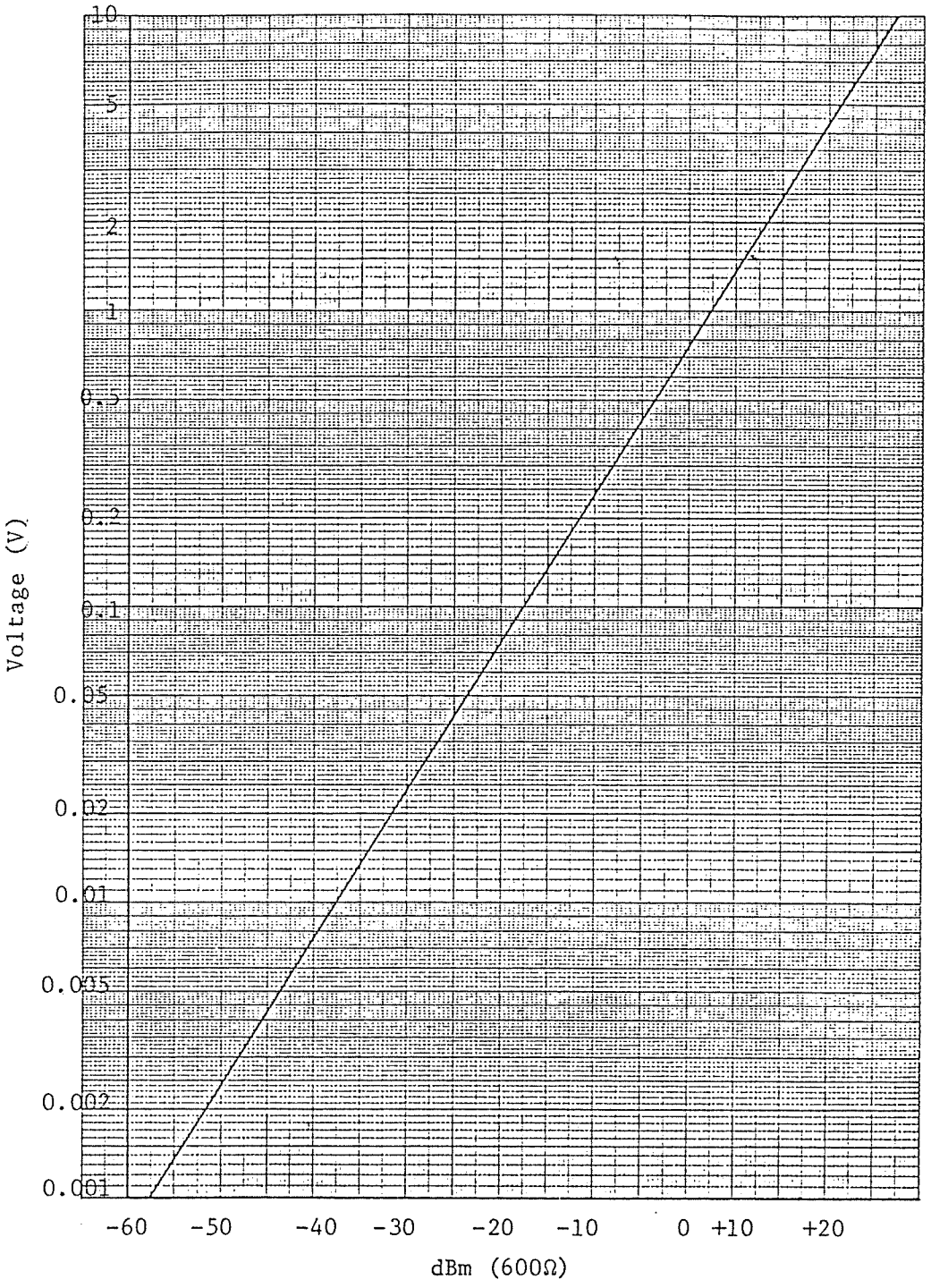
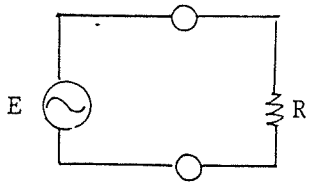


Fig.5-2 dBm (600Ω) vs. voltage conversion graph



$$P\ (W) = \frac{E^2}{R}$$

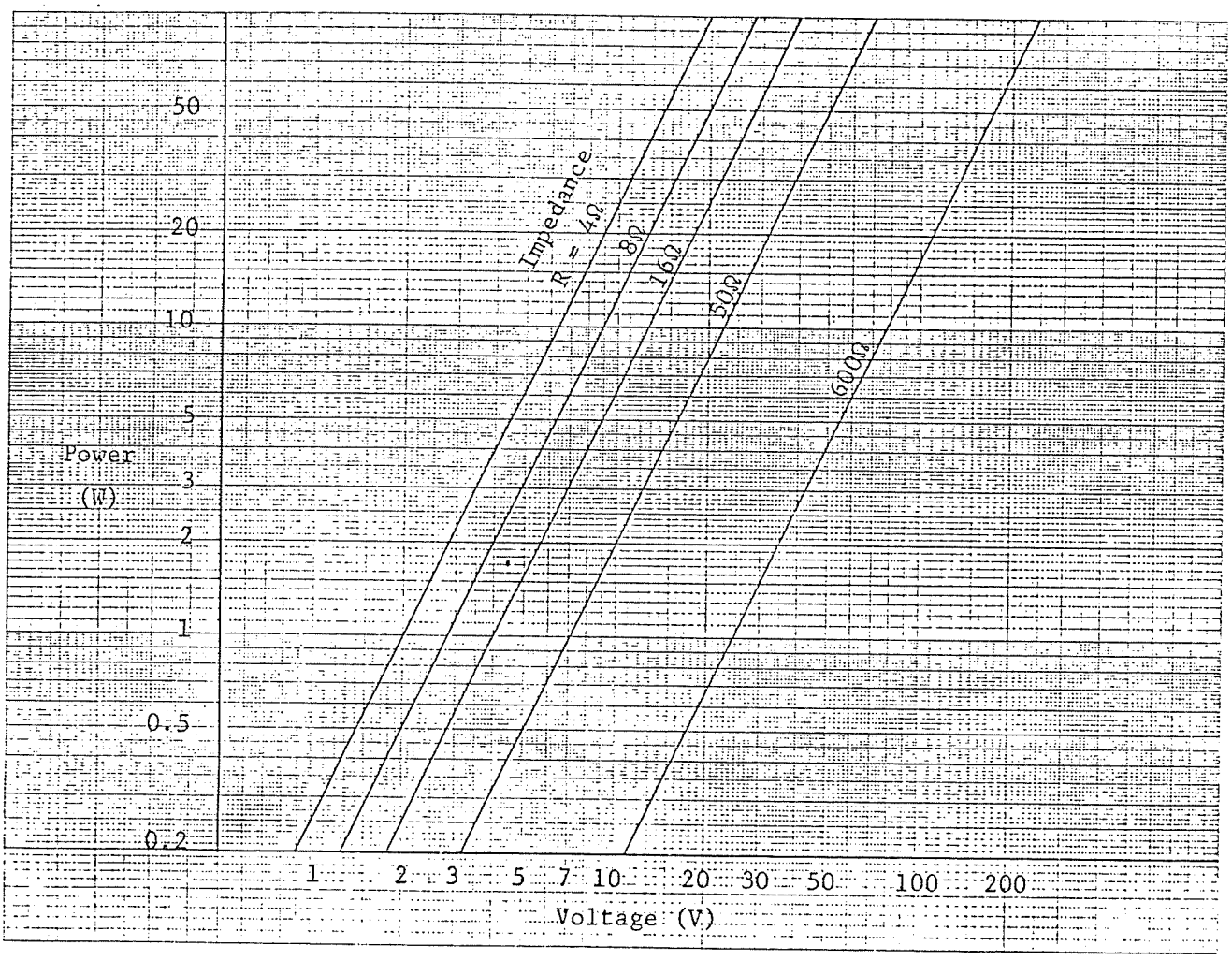


Fig.5-3 Graph for obtaining power from load impedance and voltage

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0 dBm = 1 mW (reference)

+ 20 dBm = 0.1W

+ 30 dBm = 1W

+ 40 dBm = 10W

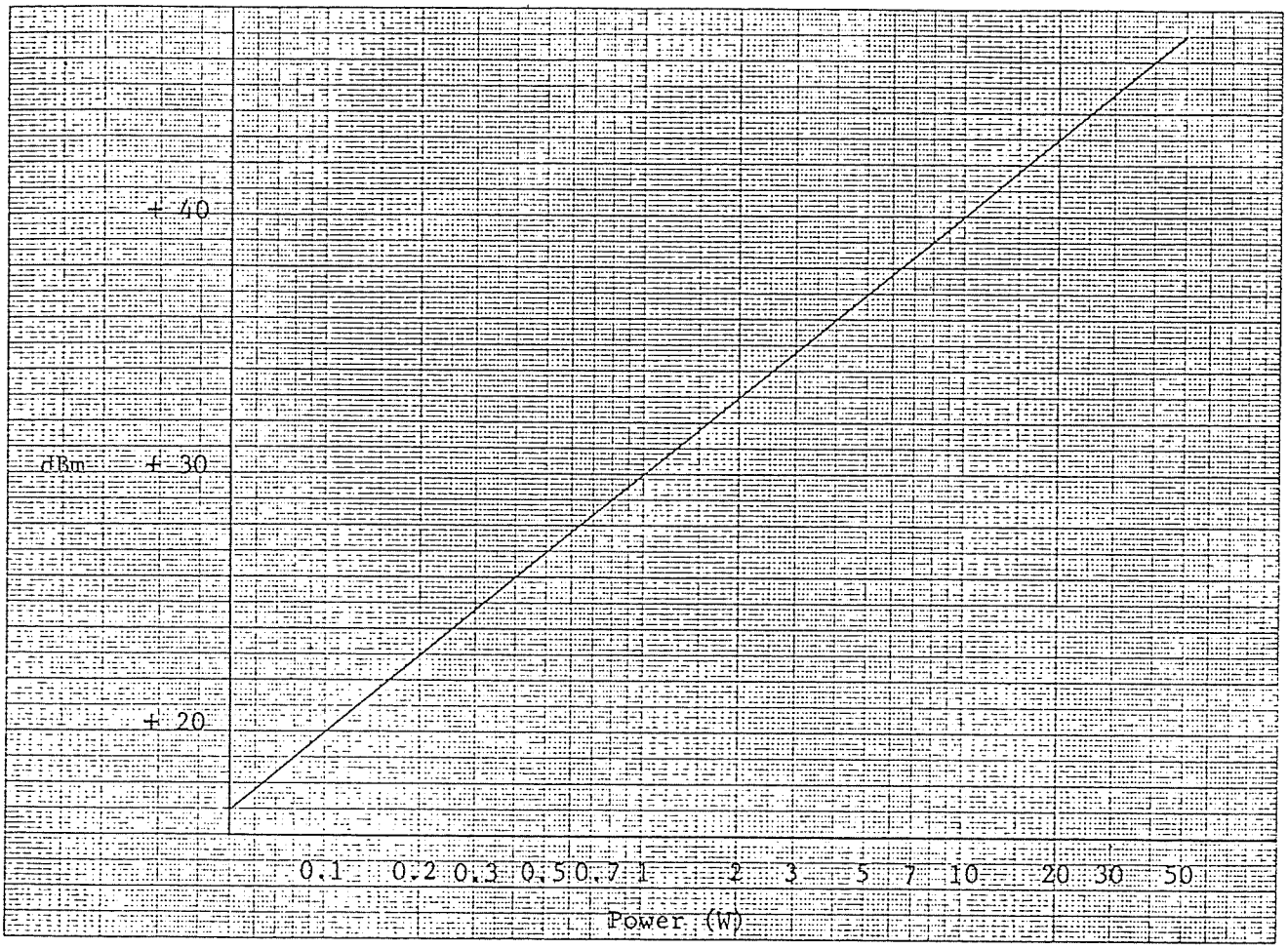

Fig.5-4 W-dBm conversion graph

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0 dBμ = 1 μV (reference)

Open voltage

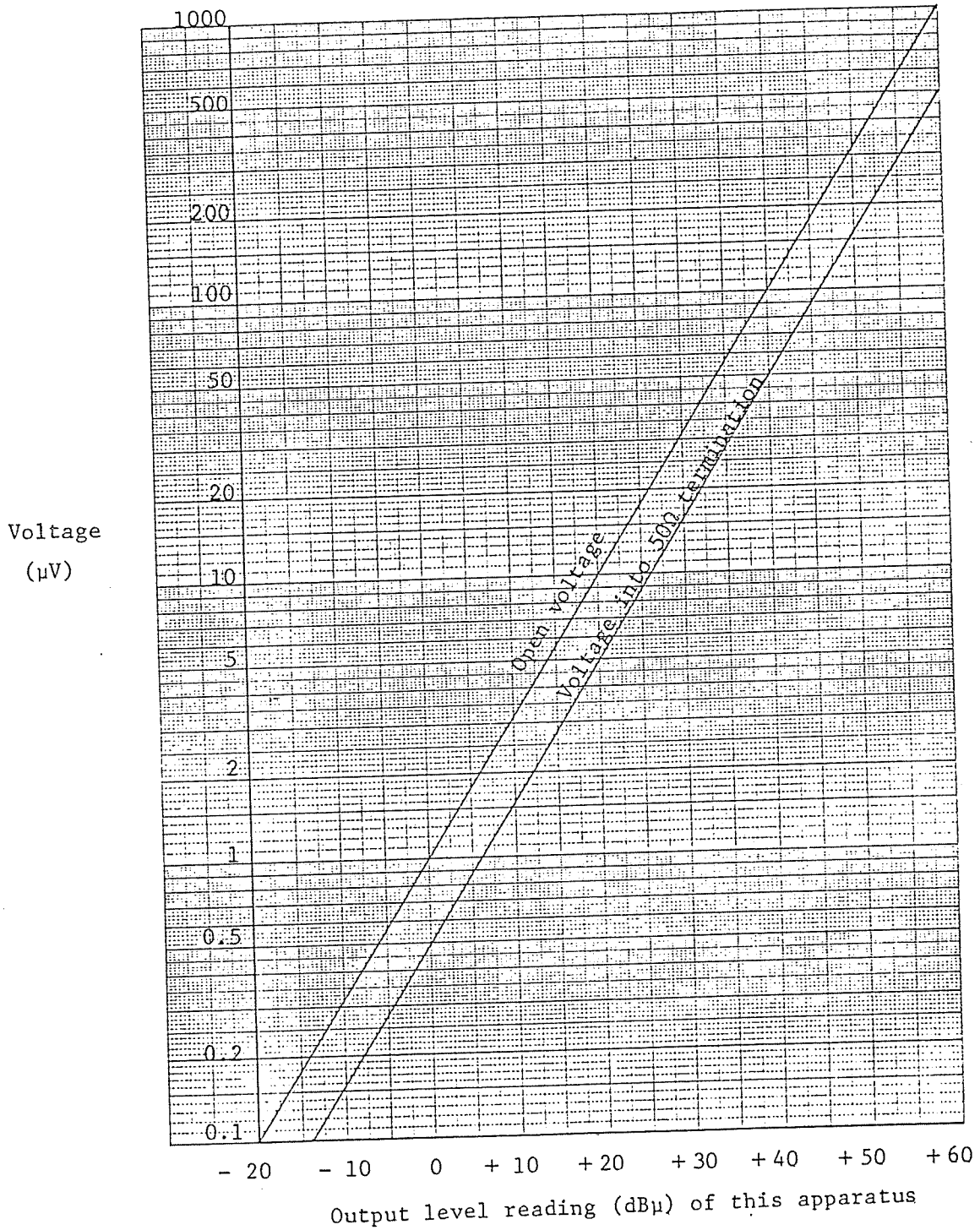

Fig.5-5 Graph for conversion between output level reading (dBμ) of this apparatus and voltage (μV)

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5.5.5 [RF OUTPUT (- 40 dB)] frequency response

When an input signal is connected to [RF INPUT/OUTOUT] with the measurement item set at [RF OUTPUT (REAR)], a signal, which is attenuated by 40 dB (power ratio 1/1000) as compared with the input signal, is available at [RF OUTPUT (- 40 dB)] connector at the rear. The frequency response of [RF OUTPUT (- 40 dB)] is shown in Fig.5-6.

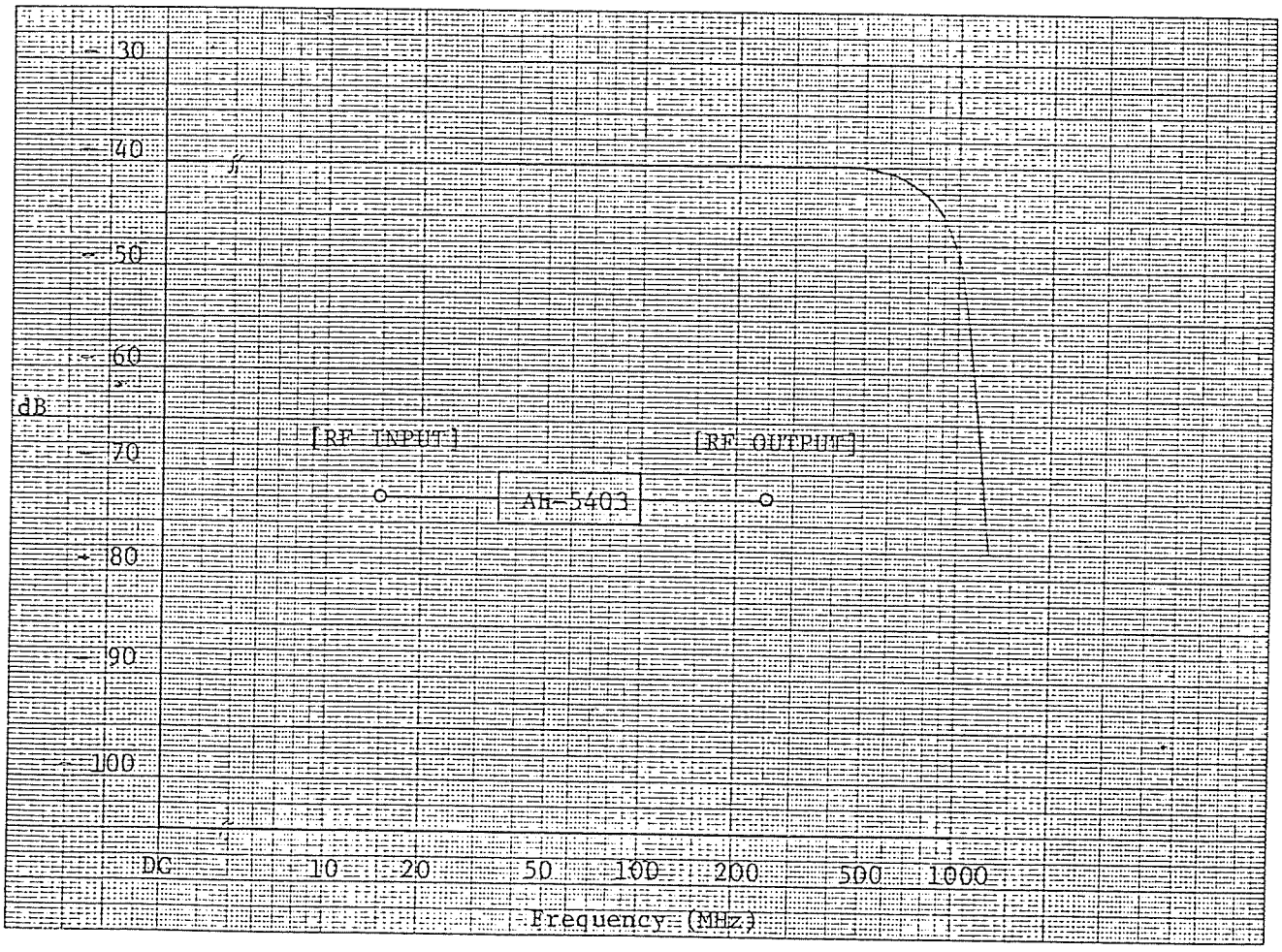

Fig.5-6 [RF OUTPUT] frequency response

SECTION 6

TROUBLESHOOTING

6.1 Introduction

This section describes troubleshooting procedures for any trouble which does not indicate that this apparatus is faulty. In the following cases, make thorough examination.

6.2 Troubleshooting

The quality of this apparatus is given every consideration. Any symptom listed in Table 6-1 does not indicate that this apparatus is faulty, and should be examined thoroughly. If any trouble occurs or any other symptom not shown occurs even after the procedures of Table 6-1 have been performed, consult the manufacturer's sales office or factory. It is prohibited for the user to attempt internal modification, adjustment, repair, etc. Repair should be done, as a rule, at the factory.

Table 6-1

	Symptom	Probable cause	Remedy
	Power is not applied.	Incorrect connection of the power cord.	Reconnect the power cord.
		Poor contact of the power plug.	Check the power plug.
		Blown out fuse.	Replace the fuse.
Transmitter test	RF power can not be measured. RF frequency can not be measured.	Measurement item is not at [TRANSMITTER TEST].	Depress ▼ or ▲ button to set the measurement item to [TRANSMITTER TEST]. (A red lamp lights.)
		Due to poor contace of the microphone connector, the press-to-talk switch does not operate.	Check the microphone connector and micro-phone cord.

	Symptom	Probable cause	Remedy
Transmitter test		Open or short in the connecting cord to the transceiver.	Check the connecting cord.
		Measurement item is not at [RF FREQUENCY]. [COUNTER MODE] is at [EXT].	Depress [EXT] switch to [INT].
		The input frequency is in excess of the frequency range of [INPUT SELECT].	Set the input frequency range to the input frequency.
	Modulation (internal) is not applied to the transceiver.	Poor contact of the microphone connector.	Check the microphone connector and microphone cord.
		[MODE SELECT] switch is at [OFF].	Turn [MOD SELECT] switch to [1 kHz].
		[LEVEL (PULL HIGH)] knob is turned counterclockwise.	Turn the knob gradually clockwise. In the case of a carbon microphone, full the knob to this side and then turn it clockwise.
	Modulation sensitivity can not be measured.	Measurement item is not at [AUDIO SENSITIVITY].	Depress ▼ or ▲ button to set the measurement item to [AUDIO SENSITIVITY].
		[LEVEL] range switch is set at a position of lower sensitivity.	Raise [LEVEL] range gradually from [+ 20 dBm]. and set it at a position for easy reading of the level meter.
	Audio signal deviation can not be measured.	[DEVIATION kHz] range is set at [1] (kHz).	Turn the range to [5], [10] or [20] (kHz).

	Symptom	Probable cause	Remedy
Receiver test	Tone signal deviation can not be measured.	[AF BW] switch is set at [400 Hz ~3 kHz].	Turn [AF BW] switch to [30 Hz ~ 3 kHz].
		Modulation with tone signal is not applied to the transceiver.	Apply tone signal modulation.
		[DEVIATION kHz] range is set at [5], [10] or [20] (kHz).	Turn the range to [1] (kHz).
	AF level 100% set can not be done.	[LEVEL % dB] range is set at [+ 10] or [+ 20].	Turn [LEVEL % dB] range to [0].
		[100% SET] switch is set at an improper position.	Select [0 dB], [+ 10 dB] or [+ 20 dB] so that the level meter may deflect.
		100% set knob is turned counterclockwise.	Turn it clockwise.
	Distortion factor can not be measured.	Modulation with tone signal is applied.	Set [AF BW] switch to [400 Hz ~3 kHz].
		Modulation frequency is not 1 kHz ± 10 Hz (in the case of external modulation).	Set the frequency of the oscillator for external modulation to 1 kHz ± 10 Hz.
	S/N can not be measured.	Modulation with tone signal is applied.	Set [AF BW] switch to [400 Hz ~3 kHz].
	Audio signal modulation can not be applied to signal generator.	(In the case of internal modulation) [MOD SELECT] switch is set at [OFF].	Turn [MOD SELECT] switch to [1 kHz] or [INT].
		(In the case of external modulation) [MOD SELECT] switch is set at [EXT].	Turn [MOD SELECT] switch to [EXT].
		[1 kHz OR EXT] knob of [MOD RATE] is turned counterclockwise.	Turn the knob gradually clockwise.

	Symptom	Probable cause	Remedy
Receiver test	Tone signal modulation can not be applied to the signal generator.	[MOD SELECT] switch is not at [INT]. [DEVIATION kHz] range is set at [5], [10] or [20] (kHz).	Depress [MOD SELECT] switch to [INT]. Turn the range to [1] (kHz).
	100% set at [AF LEVEL SET] can not be done.	[LEVEL % dB] range is not at [100%, 0 dB]. [100% SET] switch is set at [+ 20 dB] or [+ 10 dB].	Set the range to [100%, 0 dB]. Set the switch to [0 dB].
		Input level varying knob is turned counter-clockwise.	Turn the knob gradually clockwise.
	Distortion factor can not be measured.	Input frequency is not 1 kHz ± 10 Hz.	Check the input frequency.
	In the 20 dB NOQ measure-ment, N setting can not be done.	[OUTPUT LEVEL dBμ] toggle switch is turned to left.	Turn the toggle switch to right, and turn ATT knob counterclockwise to lower the output level.

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